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ABSTRACT

This catalog includes abstracts of each of the papers delivered at the Arctic Science Conference. The conference was divided into the following symposia: (1) "Biochemistry and Molecular Biology"; (2) "An Update of Alaskan Science and Discovery"; (3) "Science Education for the Public"; (4) "Hubbard Glacier, Russell Fjord and Situk River Studies"; (5) "Porcupine Caribou Herd"; (6) "Advising High School Teachers and Counselors on Engineering"; (7) "ANCSA (Alaska Natives Claims Settlement Act): Looking Ahead to 1991"; (8) "Alaska Education Using Telecommunications"; (9) "Programs and Perspectives in Alaska Native Science"; and (10) "Science Education". Technical sessions include the physical sciences; social sciences; engineering and engineering education; mathematics, statistics, computer science; and the biological sciences. Descriptions of the workshops and the poster sessions are included. (KR)

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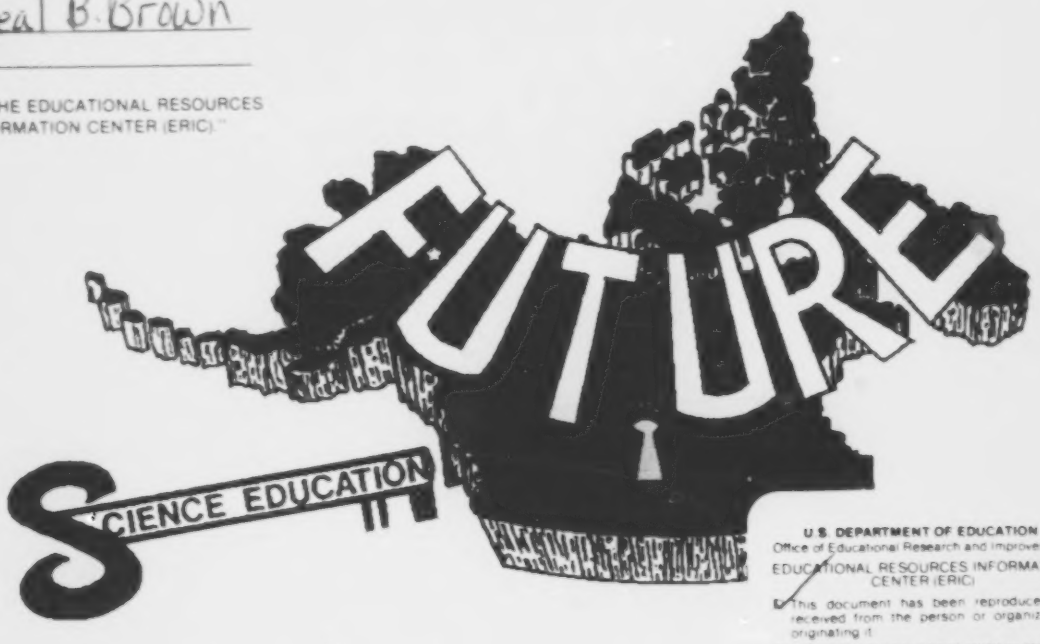


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## 1988

## 39th ARCTIC SCIENCE
# CONFERENCE PROCEEDINGS

## American Association for the Advancement of Science–Arctic Division

October 7 - 10, 1988 • University of Alaska Fairbanks

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# SCIENCE EDUCATION

1988 ARCTIC SCIENCE CONFERENCE
FAIRBANKS, ALASKA

# PROCEEDINGS

SUMMARIES OF SELECTED SESSIONS AND ABSTRACTS OF PAPERS

Published by

American Association for the Advancement of Science
Arctic Division

and

Geophysical Institute
University of Alaska Fairbanks

October 7-10, 1988

## AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCES

### OFFICERS OF THE ARCTIC DIVISION

(1 October 1987 - 30 September 1988)

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| President-Elect: | Francis S.L. Williamson<br>Institute of Arctic Biology<br>University of Alaska Fairbanks<br>Fairbanks, AK 99775-0180<br>(907) 474-7648 |
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## *ACKNOWLEDGMENTS*

The 1988 Arctic Science Conference owes much to the efforts by the chairs of the symposia and sessions:

| | | |
|---|---|---|
| Symposium I: | Biochemistry and Molecular Biology | Lawrence Duffy |
| Symposium II: | An Update of Alaskan Science and Discovery | Gunter Weller |
| Symposium III: | Science Education for the Public | Larry Mayo |
| Symposium IV: | Hubbard Glacier, Russell Fjord & Situk River Studies | Larry Mayo |
| Symposium V: | Porcupine Caribou Herd | Robert White |
| Symposium VI: | Advising High School Teachers and Counselors on Engineering | Vince Haneman |
| Symposium VII: | ANCSA: Looking Ahead to 1991 | Terry Haynes/ Linda Green |
| Symposium VIII: | Alaska Education Using Telecommunications | Ron Inouye/ Steve Smith |
| Symposium IX: | Programs and Perspectives in Alaska Native Science and Education | David Norton |
| Symposium X: | Science Education | John Morack/ Helen Barrett |
| Technical Session A: | Physical Sciences | Larry Mayo |
| Technical Session B: | Social Sciences | Terry Haynes |
| Technical Session C: | Engineering and Engineering Education | John Zarling |
| Technical Session D: | Mathematics, Statistics, Computer Sciences | Gary Gislason |
| Technical Session E: | Biological Sciences | Lawrence Duffy |
| Posters/Exhibits | | Mary Ann Borchert |

Organization of the Conference depended greatly on the assistance of additional individuals:

- Debbie LaBarre (Geophysical Institute Steno Service Center) typed most of the Proceedings and Program;
- Sharon Oien and Nancy Bachner (UAF Conferences and Institutes) and Helen Barrett (Fairbanks North Star Borough School District) handled the logistics of the Conference;
- Nancy Smoyer provided much of the last-minute organization;
- Cindy Wilson coordinated the Conference, with great skill and dedication through all its phases.

The officers of the AAAS-Arctic Division would like to thank all of the above for their help, and particularly Cindy Wilson whose talents and hard work ensured the success of the Conference.

## *LIST OF SUPPORTERS*

THE 1988 ARCTIC SCIENCE CONFERENCE
(39th Alaska Science Conference)

gratefully acknowledges the financial and in-kind support from the following organizations:

American Association for the Advancement of Science

American Microbiological Society

American Meteorological Society

Arctic Institute of North America

Fairbanks North Star Borough School District

National Science Foundation, Division of Polar Programs

National Science Foundation, Directorate of Science & Engineering Education

State of Alaska

Sigma Xi/Alaska

University of Alaska Fairbanks

University of Alaska Foundation

# TABLE OF CONTENTS


AAAS - OFFICERS OF THE ARCTIC DIVISION ..... ii

ACKNOWLEDGMENTS ..... iii

LIST OF SUPPORTERS ..... iii

TABLE OF CONTENTS ..... v

WELCOME ..... 1

GENERAL INFORMATION ..... 3

SCHEDULE OF EVENTS ..... 7

Symposia

I. BIOCHEMISTRY AND MOLECULAR BIOLOGY ..... 11
II. AN UPDATE OF ALASKAN SCIENCE AND DISCOVERY ..... 23
III. SCIENCE EDUCATION FOR THE PUBLIC ..... 31
IV. HUBBARD GLACIER, RUSSELL FJORD AND SITUK RIVER STUDIES ..... 45
V. PORCUPINE CARIBOU HERD ..... 53
VI. ADVISING HIGH SCHOOL TEACHERS & COUNSELORS ON ENGINEERING .. 59
VII. ANCSA: LOOKING AHEAD TO 1991 ..... 61
VIII. ALASKA EDUCATION USING TELECOMMUNICATIONS ..... 63
IX. PROGRAMS & PERSPECTIVES IN ALASKA NATIVE SCIENCE & EDUCATION ..... 71
X. SCIENCE EDUCATION ..... 83

Technical Sessions

A. PHYSICAL SCIENCES ..... 109
Sections
1. Global Change and the High Latitudes ..... 111
B. SOCIAL SCIENCES ..... 133
Sections
1. Current Themes in Arctic and Subarctic Social Science ..... 135
2. Peoples and Cultures of Southwest Alaska ..... 143
3. Contribution of the Social Sciences to Land Use Planning and Resource Management in Alaska ..... 145
C. ENGINEERING AND ENGINEERING EDUCATION ..... 151
Sections
1. Alaska's Engineering Education: Its Future ..... 153
2. Engineering Research ..... 157
D. MATHEMATICS, STATISTICS, COMPUTER SCIENCES ..... 167
E. BIOLOGICAL SCIENCES ..... 177
Sections
1. Current Themes in Medical Research ..... 179
2. Modern Ecology ..... 193
3. Ecology and Quaternary Studies ..... 205
4. Physiological Ecology, Behavior and Systematics ..... 213
5. Applied Resource Management ..... 221

Workshops

1. ALASKA SCIENCE AND TECHNOLOGY FOUNDATION ..... 227
2. COMMITTEE ON ARCTIC SOCIAL SCIENCES, POLAR RESEARCH BOARD .. 231

POSTERS ..... 233

INDEX OF AUTHORS ..... 261

## *WELCOME*

Professional growth is the common goal for those who attend a conference and for those who have planned that conference. Our individual judgment of the worth of this particular conference will be decided by how we feel about it after we return home. Commit yourself now to ask questions of speakers, presenters, and panel members. Introduce yourself to those you want to meet.

You can be sure that everyone here shares some aspect of your own commitment to the north. It should take only a few moments of conversation to discover what common interests you have with almost anyone attending this conference.

These Proceedings provide you with the detail that fills the framework laid out in the meeting announcements. We hope you will find what you came for. We hope you will actively support the theme, SCIENCE EDUCATION. We hope you make this the best continuing opportunity for northern scientists from a wide range of disciplines to meet and communicate.

Enjoy your meeting.

Neal B. Brown

## GENERAL INFORMATION

Conference Headquarters:

- FRIDAY, October 7 — Regents' Great Hall, University of Alaska Fairbanks
- SATURDAY and MONDAY, October 8-10 — Entrance, Ryan Middle School, Fairbanks

The registration staff will provide assistance with program information, audio and visual aids for the technical and poster sessions, exhibits, and other administrative needs. Information on tours and other Fairbanks events will also be available.

Registration:

The desk will be open:

| | | |
|---|---|---|
| FRIDAY, October 7 | 7:30 am-5:00 pm | Regents' Great Hall, University of Alaska Fairbanks |
| SATURDAY, October 8 | 7:30 am-5:00 pm | Entrance, Ryan Middle School |
| MONDAY, October 10 | 7:30 am-4:00 pm | Entrance, Ryan Middle School |

Conference Fees:

Registration (includes Reception, October 7)

| | |
|---|---|
| Full Conference (includes Proceedings) | $60.00 |
| Graduate Student (includes Proceedings) | $30.00 |
| One Day (without Proceedings) | $20.00 |
| One Day - Graduate Student (without Proceedings) | $10.00 |
| Undergraduate/High School Students | $Free |
| Copy of Proceedings | $15.00 |
| Credit Course - Ed. 593 | $15.00 |
| Conference Dinner, October 7 | $21.00 |
| Luncheon: American Society of Circumpolar Health, October 8 | $ 7.00 |
| Brunch: Association for Women in Science, October 9 | $ 8.00 |

Badges:

Your Conference name badge will be your ticket of admission to all Conference sessions and exhibits. Each participant should obtain a name badge at the registration desk prior to attending any of the sessions.

Messages:

There will be a message board near the registration desk. Messages can be telephoned in to the registration desk on Friday at the University of Alaska at (907) 474-7258 or 7260, and on Saturday and Monday at Ryan Middle School at (907) 452-4751.

Credit Course:

A one-credit course, Ed. 595, will be held in conjunction with the Conference. There will be a mandatory meeting on Saturday, 8:00-8:30 am, Room 3, Ryan Middle School. For more information, contact Conferences and Institutes (907) 474-7800. Other credit and non-credit courses will be offered through the Fairbanks North Star Borough School District; for more information contact Helen Barrett (907) 474-2000.

Slide Preview Room:

FRIDAY, October 7 — Kayak Room, Regents' Great Hall, Univ. of Alaska Fairbanks
SATURDAY and MONDAY, October 8 and 10 — Room 50, Ryan Middle School

It is recommended that slides be previewed in order to be sure that they are oriented properly in the carousel trays. Extra trays will be available in the slide preview rooms.

Science Films:

FRIDAY, October 7 — Regents' Great Hall, University of Alaska Fairbanks
SATURDAY and MONDAY, October 8 and 10 — Room 41, Ryan Middle School

A series of films will be shown throughout the Conference. Films include: "Make Prayers to the Raven", "We of the River", "Frostbite and Other Cold Injuries", "Photosynthesis", and "Vectors". Program notes will be available at the time of screening.

Poster Sessions:

SATURDAY and MONDAY, October 8 & 10 — Multi-purpose Rm, Ryan Middle School

The poster sessions will be displayed on Saturday and Monday. Authors will be available for questions at their posters from 12:30-1:30 pm.

Exhibits:

FRIDAY, October 7 — Regents' Great Hall, University of Alaska Fairbanks
SATURDAY and MONDAY, October 8 & 10 — Multi-purpose Rm, Ryan Middle School

Coffee Service:

Complimentary coffee and rolls will be available each morning at 7:30 am near the Registration Desk. Coffee will be available throughout the day.

Transportation:

A shuttle bus service will be provided between the Westmark Hotel and the University of Alaska and Ryan Middle School. A schedule will be posted in the Westmark Hotel and at the Conference. The pick-up point at the University will be in the Safety and Security parking lot.

Special Events:

FRIDAY, October 7

School of Engineering Open House/Tour — 10:00-11:50 am, Room 531, Duckering Building, University of Alaska Fairbanks, followed by a reception at noon. Teachers and students are invited to attend.

Geophysical Institute Open House – 1:00-5:00 pm. Tours and presentations of various research areas. Students are encouraged to visit.

Arctic Institute of North America (AINA) Board of Governors will hold its annual meeting from 3:00-5:00 pm, Room. Sub B, Wood Center, University of Alaska Fairbanks.

AAAS Reception — 5:00-6:30 pm, Regents' Great Hall, University of Alaska Fairbanks. Meet old friends and make new ones.

Conference Dinner — 6:30 pm, Wood Center Ballroom, University of Alaska Fairbanks. Dr. Thomas F. Malone, President, Sigma Xi, will speak on *"The Scientific and Societal Challenge of Global Change."* The dinner is co-sponsored by AAAS, Sigma Xi and the American Microbiological Society. Awards for excellence in science and teaching will be presented.

SATURDAY, October 8

Fairbanks Professional Engineering Societies Breakfast — 8:00-9:00 am, Wood Center, University of Alaska Fairbanks.

American Society of Circumpolar Health Luncheon and Annual Meeting — 12:00-1:30 pm, Room 37, Ryan Middle School.

Alaska Natural Resources and Outdoor Education Association Reception — 7:00 pm. ANRA will host a reception for members and friends at the Alaska Public Lands Information Center, 3rd and Cushman, Fairbanks.

SUNDAY, October 10

Association of Women in Science, Alaska Chapter (AWIS-AK) Brunch — 10:00 am, Gold Room, Westmark Hotel. AWIS-AK has invited Sue Kemnitzer, Executive Director of the Federal Task Force on Women Minorities, and the Handicapped in Science and Technology to speak on *"Changing America: The New Face of Science and Engineering"*. This meeting is open to Conference registrants and the public. Make reservations at the Conference Registration Desk.

Open Houses:

Geophysical Institute

1:00-5:00 pm, – Tours and presentations of various research areas

Musk Ox Farm (Large Animal Research Station)

1:00-5:00 pm — Open for viewing of animals and station
1:30 pm and 3:00 pm (45-minutes) — Tours of station

Museum, University of Alaska Fairbanks

12:00-5:00 pm — Open ($2.00 admission with discount coupon included in registration materials)
2:00 pm and 3:00 pm (45-minutes) — Tours of galleries and collections area, including lecture on recent dinosaur discoveries in area

Rasmuson Library, University of Alaska

1:00-5:00 pm — Open for viewing of Alaska and Polar Regions Department containing the world's largest collection of Alaska and polar regions materials and the Alaska archives
1:30 pm (30-minutes) — Lecture on "History of Science in Alaska"

Poker Flat Research Range

1:00-5:00 pm — Tours of rocket range every hour on the hour

Alaska Natural Resource and Outdoor Education Association Meeting — 1:00-3:00 pm, Memorial Conference Room, Wood Center, University of Alaska Fairbanks.

Arctic Research Consortium of the United States (ARCUS) First Annual Meeting — 1:00-5:30 pm, Gold Room, Westmark Hotel followed by cocktails and dinner. More information is available at the Registration Desk or by contacting Luis Proenza (907) 474-7314.

Alaska Science Teachers' Consortium, Steering Committee Meeting — 4:30 pm, followed by dinner. All members are invited to participate. Location to be announced.

MONDAY, October 11

AAAS – Arctic Division Business Lunch – 11:30-1: pm, Room 29, Ryan Middle School.

FNSBSD Library Media Staff Reception, 4:15 pm, Hering Foyer/Lathrop Cafeteria. Everyone is invited.

12

## *SCHEDULE OF EVENTS*

**FRIDAY, October 7: University of Alaska Fairbanks**

| Time | Subject |
|---|---|
| 7:30 | Registration |
| 8:30 | Science Films |
| 8:30 | Introduction |
| 8:35 | Welcome Remarks and Address |
| 8:45 | Plenary Session: A New Focus on the Arctic |
| 10:15 | School of Engineering Open House/Tour |
| 10:15 | Workshop 1: Alaska Science and Technology Foundation |
| 10:15 | Symposium I: Biochemistry and Molecular Biology |
| 10:15 | Symposium II: An Update of Alaskan Science and Discovery |
| 12:00 | Lunch |
| 1:00 | Open House: Geophysical Institute — Students encouraged to attend |
| 1:30 | Workshop 2: Committee on Arctic Social Sciences, Polar Research Board |
| 3:00 | Annual Meeting: Arctic Institute of North America (AINA) Board of Governors |
| 3:15 | Symposium IIIa: Science Education for the Public |
| 5:00 | Reception: Sponsored by the American Association for the Advancement of Science - Arctic Division |
| 6:30 | Conference Dinner: "The Scientific and Societal Challenge of Global Change" by Dr. Thomas F. Malone, President Sigma Xi, Dinner is co-sponsored by AAAS - Arctic Division, Sigma Xi, and the American Microbiological Society |

**SATURDAY, October 8: Ryan Middle School** (Unless Otherwise Noted)

| Time | Subject |
|---|---|
| 7:30 | Registration |
| 8:00 | Ed. 593 Credit Course Meeting |
| 8:30 | Science Films |

**SATURDAY, October 8: Ryan Middle School (cont'd)**

| | |
|---|---|
| 8:30 | Poster Session |
| 8:00 | Breakfast: Sponsored by Fairbanks Professional Engineering Societies (Wood Center, UAF) |
| 8:30 | Symposium IV: Hubbard Glacier, Russell Fiord and Situk River Studies |
| 8:30 | Technical Session B1: Social Sciences — Current Themes in Arctic and Subarctic Social Science |
| 8:30 | Technical Session D: Mathematics, Statistics, Computer Sciences |
| 8:30 | Technical Session E1: Biological Sciences — Current Themes in Medical Research |
| 8:30 | Technical Session E2: Biological Sciences — Modern Ecology |
| 9:00 | Technical Session C1: Engineering and Engineering Education — Alaska's Engineering Education: Its Future |
| 10:15 | Technical Session A1: Physical Sciences — Global Change and the High Latitudes |
| 10:30 | Technical Session B2: Social Sciences — Peoples and Cultures of Southwest Alaska |
| 10:30 | Symposium V: Porcupine Caribou Herd |
| 12:00 | Luncheon Meeting: American Society of Circumpolar Health Annual Meeting |
| 12:30 | Poster Session |
| 1:30 | Symposium X: Science Education — Statewide Science/Math Symposium |
| 1:30 | Technical Session B3: Social Sciences — Contributions of the Social Sciences to Land Use Planning and Resource Management in Alaska |
| 1:30 | Technical Session C2: Engineering and Engineering Education — Engineering Research |
| 1:30 | Technical Session E3: Biological Sciences — Ecology and Quaternary Studies |
| 1:30 | Technical Session E4: Biological Sciences — Physiological Ecology, Behavior and Systematics |
| 3:40 | Technical Session E5: Biological Sciences — Applied Resource Management |
| 7:00 | Reception: Hosted by The Alaska Natural Resource & Outdoor Education Association for members and friends at the Alaska Public Lands Information Center, 3rd and Cushman, Fairbanks. |

**SUNDAY, October 9**

| Time | Subject |
|---|---|
| 10:00 | Brunch: Association of Women in Science, Alaska Chapter (AWIS-AK). Sue Kemnitzer, Federal Task Force on Women Minorities, and the Handicapped in Science and Technology will speak on "Changing America: The New Face of Science and Engineering" |
| 1:00 | Meeting: Alaska Natural Resource and Outdoor Education |
| 1:00 | First Annual Meeting of Arctic Research Consortium of the United States (ARCUS). Cocktails and dinner to follow meeting |
| 1:00 | Open House:<br>• Geophysical Institute, University of Alaska Fairbanks<br>• Poker Flat Rocket Range<br>• Museum, University of Alaska Fairbanks (Opens at 12:00 pm)<br>• Musk Ox Farm (Large Animal Research Station)<br>• Alaska and Polar Regions Department, Rasmuson Library, UAF |
| 4:30 | Alaska Science Teachers' Consortium Steering Committee; dinner to follow meeting |

**MONDAY, October 10: Ryan Middle School/Lathrop High School**

| | |
|---|---|
| 7:30 | Registration |
| 8:30 | Science Films |
| 8:15 | Opening Session: Science Education Roundtable with Verne Rockcastle, Arnold Arons and Robert Yager |
| 8:15 | Symposium VII: ANCSA: Looking Ahead to 1991 |
| 10:00 | Symposium VIII: Alaska Education Using Telecommunications |
| 10:00 | Symposium IIIb: Science Education for the Public |
| 10:00 | Symposium IX: Programs and Perspectives in Alaska Native Science and Education |
| 10:00 | Symposium X: Science Education — A detailed program has been organized by FNSBSD |
| 11:30 | AAAS Business Meeting/Lunch |
| 12:30 | Poster Session |
| 2:15 | Symposium VI: Advising High School Teachers and Counselors on Engineering |
| 4:15 | End of Conference |
| 4:15 | Reception: Hosted by Fairbanks North Star Borough School District Library Media Staff |

## *Symposium I*
## *BIOCHEMISTRY AND MOLECULAR BIOLOGY*

Chair: Lawrence Duffy
Department of Chemistry
and Institute of Arctic Biology
University of Alaska Fairbanks

# GENETICS OF METHYLOTROPHIC BACTERIA

Peggy Arps
California Institute of Technology
Environmental Engineering Science 138-78
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(818) 356-4385

Bacteria that grow on methane or methanol (methylotrophs) are currently under intensive study due to their significance for both environmental and commercial applications. These bacteria are widespread in the environment and play an important role in global carbon cycling. In addition, their unique oxidative enzymes make them of interest for biocatalysis and detoxification processes. Genetic studies are presently underway to determine the organization and expression of key methylotrophic genes. These studies include cloning and characterization of genes from different classes of methylotrophs and determination of their regulation at the molecular level.

Our studies have focused on the genes involved in the oxidation of methanol to formaldehyde, a key step in methylotrophic metabolism. To date, a total of twelve mox (methanol oxidation) genes have been identified in methanol utilizers, and the current model for this complex system will be presented.

We have also studied this system in the obligate methane utilizers, where genetics is much more difficult. DNA fragments have been cloned that contain the structural gene (moxF) for the methanol oxidizing enzyme, methanol dehydrogenase, and a second gene ($moxA_3$) that is apparently involved in assembly of the methanol dehydrogenase. My current work focuses on the $moxA_3$ gene from one of these methanotrophs.

# COMPARATIVE ASPECTS OF THE BIOCHEMICAL PROPERTIES, THE NEUROANATOMICAL DISTRIBUTION, AND THE BEHAVIORAL ROLES OF OPIOID RECEPTORS IN VERTEBRATES

Pierre Deviche, Institute of Arctic Biology, University of Alaska-Fairbanks, Fairbanks, Alaska 99775-0180

Opioid receptors and their endogenous ligands (the endorphin family peptides) have been proposed to regulate various aspects of the physiology and of the behavior of mammals.

Very little research on this subject has been done using nonmammalian vertebrates. We found that the brain of a urodele amphibian (*Taricha granulosa*) contains specific opioid binding sites with biochemical characteristics similar to those described for mammals. Autoradiographic studies revealed that these sites are concentrated in areas of the urodele brain which are homologous to areas of the mammalian brain. Finally, the influence of opiate substances on some aspects of behavior (sexual activities, locomotion) was similar in urodeles and in mammals. Since the urodele brain apparently has retained many features of the ancestral vertebrate brain, these results suggest that the biochemical properties, the neural distribution, and the behavioral role of opioid receptors have been conserved throughout vertebrate evolution.

Arctic species of vertebrates possess unique behavioral and physiological adaptations to extreme environmental conditions. Some of these adaptations have been proposed to be partly controlled by endorphinergic mechanisms. Using modern biochemical, neurophysiological, and behavioral techniques should enable us to determine the exact nature of these mechanisms.

# PEPTIDE DESIGN AND ENGINEERING OF β-STRANDS

Lawrence K. Duffy, San Ping, Molly O'Malley and Rebecca Reynolds
Department of Chemistry and Institute of Arctic Biology
University of Alaska Fairbanks
Fairbanks, AK 99775-0180
(907) 474-7029

One of the major periodic structural motifs of proteins and peptides is the β-pleated sheet. A peptide chain in a β-strand configuration is almost fully extended rather than being tightly coiled as in the α-helix. In nature, structural units comprising from two to five β-strands are especially common. However, because of the lower solubility of some pure β-sheet proteins such as silk fibroin and β-keratin, our understanding of the properties of the β-strand is not as detailed as that of the α-helix. This is now clearly relevant because it is now known that amyloidosis is a major pathological change in aging that leads to the abnormal deposition of peptides in a fibrillar form. All amyloid fibrils share the following properties: 1) β-pleated sheet secondary structure and 2) being highly insoluble under physiological conditions. Our approach has been to design peptides where we could study the solubility, immunochemistry and biological activity of β-strand secondary structure. Our model peptide should have a hydrophobic/hydrophilic balance and also a overall charge balance. We constructed several peptides in an attempt to meet these objectives. The behavior of these synthetic peptides as well as the engineering of certain functional groups into peptides which we will construct in the future is discussed.

# MECHANISMS OF PROTEIN GELATION IN MODEL SEAFOOD SYSTEMS

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The manufacture of restructured meat and seafood products is one of the fastest growing components of the food industry, especially the seafood industry. Surimi-based products, such as shell fish analogs, formed-minced fish products, and hybrid products of minced fish with fish fillets or other meats, all require the intermolecular associations unique to myofibrillar proteins to provide the necessary structure and textural properties. Although the mechanism of action of living muscle fibers is fairly well understood, the ATP-independent self aggregation (gelation) of proteins in postmortem muscle is not clearly delineated. The ability of minced muscle to form a stable gel is very dependent on time and the treatment of the muscle preparations. Only certain fish produce minces which will form gels which set at low temperatures. Modern biochemical and molecular biological techniques have proven very useful in studying the changes in myofibril structure and the mechanisms of protein gelation.

The major protein components of minced pollock muscle are myosin, actin, tropomyosin, and troponin. Whether in living or dead fish, the interaction of these proteins is governed by their structure and basic thermochemistry. Several lines of evidence indicate that certain proteins must retain their physiological structure for myofibrillar protein preparations to gel properly.

Liquid chromatographic methods, in the presence or absence of fluorescent probes of protein hydrophobicity, polyacrylamide gel electrophoresis, and thermochemical analysis have been used to elucidate the structure and function of the proteins in minced Alaskan pollock flesh and the changes which occur following mixture with sodium chloride and subsequent heating. A variety of rheological methods have been used to evaluate the quality of the gel produced. The resulting model suggests changes in the three dimensional structure of myofibrillar proteins in addition to temperature dependent changes in the associations of the proteins with one another occur during protein gelation.

The results of these fundamental biochemical studies will be used to prepare recommendations on ways to optimize the handling and processing of minced fish products. This will result in increased product diversity, production efficiency, and economic viability of this sector of the seafood industry.

COSMID CLONING OF THE TOLUENE DIOXYGENASE ENZYME SYSTEM FROM *PSEUDOMONAS* T2 INTO *ESCHERICHIA COLI* DH1

J. J. Gosink and D. K. Button, Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, Alaska, 99775 1080, (907) 474-7708.

***Pseudomonas*** **T2, isolated from ballast water of the oil tanker** ***Mobile Arctic*** **at Port Valdez, Alaska, can use hydrocarbons such as toluene and many monoterpenes as a sole source of carbon and energy. It oxidizes toluene by the** ***meta*** **branch of the dihydrodiol pathway. Unusually small Michaelis constants for toluene metabolism suggested that this substrate was not transported into the bacterium by porters in the usual way before metabolism. Moreover toluene metabolism was not affected by protonic potential-specific ionophores such as CCCP at concentrations which eliminated amino acid transport. These results stimulated our development of the vectorial partitioning hypothesis for the transport of toluene and other hydrocarbons into biological organisms.**

Vectorial partitioning is a three-step uptake process in which a hydrophobic substrate partitions into the lipid bilayer of the cell membrane, is oxidized into a hydrophilic intermediate by intramembrane enzymes, and then diffuses into the aqueous cytoplasm for further metabolism or back out of the cell into the medium. **In this report, 40 kbp fragments of** ***Pseudomonas*** **T2 DNA were shotgun cloned via the cosmid technique into** ***E. coli*** **DH1 in an attempt to express the dihydrodiol pathway in the new host for easier manipulation of the pathway in future studies.** Approximately 9000 recombinants were obtained. Techniques are now being devised to screen for recombinants containing the dihydrodiol pathway along with any associated conventional transport systems, systems we hypothesize are not required.

# RECENT PROGRESS IN THE STRUCTURAL AND FUNCTIONAL ANALYSIS OF A PSEUDOMONAS CEPACIA DIALKYLGLYCINE DECARBOXYLASE OPERON

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We have recently determined the nucleotide sequence of a cloned 4.0 kilobase fragment of *Pseudomonas cepacia* DNA. This DNA was selected because it carries a structural gene for the 2.2-dialkylglycine decarboxylase (EC 4.1.1.64) which is expressed at a low level in the *Eschericia coli* host. The structural gene has been located by stepwise deletions of portions of the segment and determination of decarboxylase activity in host bacteria transformed with the truncated plasmids. The putative reading frame of the decarboxylase structural gene codes for a protein which very similar to that reported in the literature. This reading frame is preceded by a near-consensus Shine-Delgarno sequence. No consensus promoter sequence could be located in the -10 to -40 region, although a plasmid deleted to within 100 bases of the ATG initiation codon shows low, constitutive expression of the decarboxylase gene. Also to be discussed will be evidence obtained from gene induction data and sequence analysis which indicates that a control gene or genes exist in the 1.5 kb region upstream from the decarboxylase structural gene.

Marion H. O'Leary
University of Wisconsin Madison

Marion H. O'Leary has been at the University of Wisconsin Madison since 1968 and is currently Professor of Chemistry and Biochemistry and Associate Chairman of the Chemistry Department. He is an editor of the authoritative book "Isotope Effects on Enzyme-Catalyzed Reactions" and has authored many articles concerned with enzyme mechanisms and biochemical applications of heavy atom isotope effects. He has also served as an advisor to the government of Indonesia on education and science issues.

# NITROGEN REGULATION OF PHOTOSYNTHETIC PROTEIN SYNTHESIS

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Thylakoid membranes from nitrogen-limited cells of the green alga, Chlamydomonas reinhardtii, are altered with regard to light-harvesting functions and are depleted in photosynthetic pigments and proteins. The rates of synthesis of many photosynthetic proteins are severely impaired. Nitrogen availability does not regulate the accumulation of mRNA for plastid encoded proteins: 10 chloroplast transcripts are present at moderately high levels (60% of controls) and parallel the accumulation of total RNA, plastid RNA and chloroplast DNA. In contrast, there are dramatic decreases in the accumulation of transcripts encoding cytoplasmically synthesized proteins such as the chlorophyll a/b light-harvesting proteins (LHCP) and the small subunit of ribulose 1,5-bisphosphate carboxylase. Transcripts from these two small multigene families are differentially accumulated in response to nitrogen limitation. Increased rates of LHCP synthesis and accumulation occur during recovery from nitrogen limitation but only after LHCP transcripts accumulate to levels substantially higher than are present in nitrogen-sufficient cells. We conclude that inhibition of chloroplast protein synthesis by nitrogen is due primarily to translational attenuation. Regulation of nuclear encoded photosynthetic protein synthesis by nitrogen is achieved through mechanisms affecting transcription and/or mRNA stability.

# CLASS I ANTIGEN EXPRESSION IN ULTRAVIOLET-INDUCED MURINE SKIN TUMORS

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T lymphocytes recognize foreign antigen in the context of Class I major histocompatibility (MHC) antigens. MHC antigen density on tumor cells can be augmented in vitro in some systems by addition of gamma-interferon ($\gamma$-IFN) to cultures, and intravenous administration of $\gamma$-IFN to mice results in delayed growth or total rejection of transplanted tumors. The majority of ultraviolet light induced murine tumors (UV tumors) are rejected upon transplantation into normal syngeneic mice (regressor tumors), though these tumors will grow to eventually kill the host if transplanted into an immunocompromised animal. Some UV tumors are progressor tumors and grow in both normal and in immunocompromised animals. We have subjected several UV tumors of known transplantation phenotype to fluorescence analysis using a fluorescence activated cell sorter following culture in 100 U/ml $\gamma$-IFN and staining with the appropriate monoclonal antibodies and fluorochromes. We have found that the quantity of Class I MHC antigen expressed on the surface of these cells upon $\gamma$-IFN addition in vitro correlates with the transplantation phenotype of the UV tumor in vivo. That is, cells from regressor UV tumors, which are normally rejected upon transplantation into normal C3H/HeN mice, express elevated levels of Class I molecules after in vitro $\gamma$-IFN induction. Progressor tumors, on the other hand, express only constitutive or slightly elevated levels of Class I molecules after in vitro culture in $\gamma$-IFN.

Clones of both regressor and progressor UV tumors have been generated by soft agar cloning methods. Within both types of tumors we have found clones which are responsive to 100 U/ml $\gamma$-IFN in vitro, and these clones invariably show the regressor phenotype when transplanted into normal syngeneic hosts. We hypothesize that tumors which grow initially in the autochthonous host progress because Class I expression remains below the threshold for immune recognition of tumor antigen and destruction of tumor cells by T lymphocytes. These studies suggest a mechanism by which IFN therapy results in tumor remission in some patients.

# THE UTILITY OF ANALYSIS OF MITOCHONDRIAL DNA IN THE STUDY OF ALASKAN POPULATIONS

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Because of its simplicity, rapid rate of change and maternal mode of transmission mitochondrial DNA (mt DNA) has become a popular molecule for study among those interested in questions concerning the evolutionary history and structure of populations. The major theme of our research is to use mt DNA as a molecular marker in order to learn more about relationships and distributions of individuals within and among populations in Alaska.

We have used restriction fragment analysis as well as direct sequencing of cell free amplifications of (mt) DNA to 1.) identify individuals of unknown phylogenetic affinity, 2.) estimate extents of gene flow between contiguous populations and 3.) date periods of phylogenetic separation and adaptive radiations.

Our observations on phylogenies, molecular relationships and population structuring have been particularly useful to wildlife managers as well as students of historical population biology. Significant observations on the molecular population genetics of waterfowl, polar bears and native Alaskans will be discussed.

## *Symposium II*
## *AN UPDATE OF ALASKAN SCIENCE AND DISCOVERY*

Chair: Gunter Weller
Geophysical Institute
University of Alaska Fairbanks

# AURORA

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The history of auroral science is a history of the human exploration to the polar region, across the Arctic Circle, across the coast line of the Arctic Ocean, beyond the outer limit of the earth's atmosphere and almost to the limit of the solar system. Such efforts have led to the present understanding of the aurora which is a gigantic electrical discharge phenomenon in space around the earth. The discharge is powered by a generator process which results from the interaction between the solar wind (a supersonic flow of charged particles from the sun) and the earth's magnetic field. Major characteristics of the aurora is explained using images of the aurora taken from the ground, aircraft , a space shuttle and satellites. Effects of the aurora on the trans-Alaska oil pipeline, power transmission lines, HF radio propagation are described.

# THE ICE AGE IN ALASKA: EARTH'S CHANGING CLIMATE

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The geologic history of Alaska over the last several million years is largely a story of climate change. This period is sometimes called "The Ice Age", because glaciers and ice sheets grew to cover much of northern North America, Europe, and Asia. In Alaska glaciers expanded and contracted many times, but never covered all of the state. As a result, Alaska is one of the best locations to study many different types of geologic records of changing climate at high latitudes. Evidence of the history of climate change in Alaska has been found in lake and ocean sediments, river terraces, deposits of wind-blown dust, glacier moraines, glacier ice, and other settings.

In order to cope with the problems and opportunities of future climate change, including "Greenhouse" warming, we must better understand past climate changes. Geologic records can help determine (1) why climate changes; (2) how temperature, rainfall, sun intensity and other climatic variables change; (3) how quickly climate changes occur; (4) what the effects of past climate changes were on natural systems such as glaciers, rivers, soils, lakes, vegetation, sea level, and the atmosphere; and (5) if major natural climate changes will occur in the future.

# THE STATE OF ALASKAN GEOGRAPHY AND GEOLOGY IN 1850

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What did Alaska mean to 19th century science, for example in geology? The first comprehensive synthesis of the geography and geology of Alaska was published in 1850 (Beitrag zur Kenntniss der Orographischen und Geognostischen Beschaffenheit der Nord-West-Kueste Amerikas mit den Anlegenden Inseln). The author, Dr. Constantine Grewingk was never himself in Alaska, but, as Librarian for the Imperial Minerological Library, he had access to all the known voyage accounts as well as extensive collections of Alaskan mineral samples. In this work we see Alaska from the viewpoint of a St. Petersburg scientist. More was known than most people think. For example, the treatise catalogs all known earthquakes and volcanic eruptions, even going back before the arrival of the first Russians through oral tradition. This is still valuable today, nearly 140 years after it was published.

# SEAFOOD SCIENCE AND NUTRITION: SCIENCE FOR THE OPTIMUM UTILIZATION OF ALASKA'S FISHERIES RESOURCES

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The formation of the School of Fisheries and Ocean Sciences (SFOS) at University of Alaska Fairbanks has unified all the major fisheries programs in the university into a single academic unit. In addition to providing strong programs in traditional areas of fisheries, marine science and oceanography, SFOS provides the vehicle for the university to meet its land and sea-grant obligations to provide needed assistance to the state in development and support of its major renewable resource, fisheries. The Alaskan economy is realizing only a tiny fraction of the potential value of the State's fishery resources. In 1987, the total ground fish harvest in the north Pacific was about 4,000,000,000 pounds. Most of the fish never reached shore in Alaska, and most of those landed were only processed to an intermediate state before leaving the State. Maximizing the value added-economic benefits to the people of Alaska starts with the training in Alaska of fisheries professionals with the knowledge of the resource, an appreciation of its uses, and a stake in the outcome.

There are over 1000 commercial food fish marketed in the U.S. Some of these are raised by aquaculture, but most are harvested wild. It is important that fisheries scientists have strong interdisciplinary backgrounds since wild stocks must be managed, harvested during specific seasons, held until processing, processed into intermediate or final seafood products and marketed through the tangled web of product identity. Fisheries professionals working in Alaska must span the range from fisheries ecology and biology thru management and ecomonics to an appreciation of the factors which make seafood production unique from other food sciences and the cultural and economic factors which make Alsaka unique. This requires the development of a seafood science and nutrition program. The objectives of this program would be to train the students in scientific and engineering principles that are needed to produce wholesome, nutritious, safe, convenient, attractive, and affordable seafood products on a commercial scale and to provide an appreciation of the relationship of seafood production to Alaska's fisheries resources.

The SFOS faculty at the Fishery Industrial Technology Center (FITC) in Kodiak are developing seafood science and nutrition options along three general lines. First, a B.S. degree program with Oregon State University under the Western Undergraduate Exchange program. Students in this program would take two years of classes at U of Alaska followed by three years split between classes on the OSU campus in Corvallis and internships in the Alaskan seafood industry. Second, a M.S. degree program with graduate course work in Fairbanks and dissertation research at the FITC or another appropriate site. Third, a emphasis in seafood science within the Ph.D. program in Fisheries.

# ALASKA'S ANCIENT AND EXTINCT FAUNA

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Throughout the last two million years, Alaska has been more Asian than North American. It was the eastern wing of a vast Eurasian Mammoth Steppe, populated by horses, mammoths, steppe bison, saiga antelope, lions, and other species which would seem out-of-place in Alaska today. Much of this fauna became extinct sometime between 11,000-13,000 years ago, at the time of a major climatic and vegetational change. The dry steppes were transformed into wet tundra and taiga. The Mammoth Steppe fauna were replaced by species like moose and black bear which were new to Alaska. The relatively depauperate large mammal fauna of today's Alaska is quite unlike the rich diversity of the relatively recent past. It was during this revolutionary time at the end of the last ice age that Asian people colonized Alaska — and then south to the rest of North America.

## *Symposium III*
## *SCIENCE EDUCATION FOR THE PUBLIC*

Chair: Larry Mayo
U.S. Geological Survey
Fairbanks, Alaska

# TEACH ABOUT GEESE CURRICULUM

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The U.S. Fish and Wildlife Service and other wildlife management agencies are using a comprehensive education program to tackle a complex wildlife management issue. The results thus far: A decline in hunting, a new awareness among the people affected, and a strong foundation laid for a long term, long lasting education program. Plus, "Alaskanized" wildlife instructional materials for teachers on the Yukon-Kuskokwim Delta!

Populations of four species of geese which nest in the Yukon-Kuskokwim Delta and migrate along the Pacific Flyway have declined severely over the last twenty years. Overhunting is one of the main factors contributing to the decline, and is one factor which people can influence.

The Yukon-Kuskokwim Delta Goose Management Plan provides a cooperative framework for the research and management efforts dedicated to reverse the goose population decline. A vital aspect is the Information and Education Program, designed to inform Pacific Flyway residents about the Plan, and to encourage voluntary reduction of hunting. An important component of the Information and Education Program is the "Teach About Geese" curriculum.

It is often difficult for teachers in rural Alaska to get materials that are "Alaskanized." Materials which address wildlife seem especially welcome, as wildlife is relevant to the lives of the students. The U.S. Fish and Wildlife Service, and the Alaska Natural Resource and Outdoor Education Association (ANROE), had been teaching credit courses statewide on wildlife education curricula: Project WILD, CLASS Project, Alaska Wildlife Week and Alaska Sea/River Week. The next step was to "Alaskanize" and "goosize" these materials and offer workshops for teachers. A pilot workshop was held, draft curriculum produced, and input from field testing workshops incorporated into the final materials, called "Teach About Geese".

The final materials for "Teach About Geese" are in a kit format. A teacher reference booklet ("Facts About Geese") and the lesson plans provide the heart of the kit. A four color poster, seven charts, and two game boards are included. In addition, a supplement contains reproducible "Teach About Geese" (TAG) sheets. The TAG sheets include all the student materials needed to complete the lesson plans. Many other extras are included with the kit. Each school on the Yukon-Kuskokwim Delta National Wildlife Refuge will get a kit, and copies of the curriculum guide for each teacher. A field trip kit will also be made available to Yukon-Delta teachers through the school district offices.

The "Teach About Geese" curriculum represents much more than simply informational materials. It represents implementation of a way of teaching about critical wildlife issues through experimental learning. It represents the adaptation of excellent available materials to meet local needs and concerns. It represents material developed with input from those who will be its ultimate users. It represents a cooperative effort among many individuals and agencies to provide training and credit courses for rural Alaskan teachers. It represents an issue concerning a resource shared by people along the Pacific Flyway, being addressed with a voluntary, educational approach.

A cadre of highly qualified workshop facilitators is ready to conduct credit courses and inservices for the 88-89 school year.

# A POLAR BIBLIOGRAPHIC INFORMATION NETWORK:

# PRESENT STATUS AND FUTURE PLANS

Martha Andrews

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The Northern Libraries Colloquy, recently renamed the Polar Libraries Colloquy, is an international forum for exchange of information and ideas among the polar bibliographic community. The Twelfth Northern Libraries Colloquy was held from 5 to 9 June 1988, at the University of Colorado in Boulder. The conference was planned around the theme Northern Information - The Global Connection. The invited and contributed papers relating to this theme led to a recommendation at the business meeting for the formation of a working group to coordinate a Polar Information Network. The present status and future plans for the development of this network are discussed in this paper. At present, polar information resources are commercially accessible online in at least two dozen area and subject oriented reference databases. In addition, three bibliographic utilities contain cataloging information for several thousand (mainly monographic) items in many different libraries worldwide. New technologies, including 1)CD-ROM and 2) intelligent interfaces, offer new opportunities for increasing user accessibility to polar information.

# LE CONTE GLACIER STUDY

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Le Conte Glacier, 20 miles southeast of Petersburg, is the southern most tidewater glacier in North America, and is one of a dozen glaciers that make up the huge Stikine Icefield that straddles the crest of the Coast Range Mountains which divide the U.S. from Canada. Le Conte Glacier's position and geological surroundings are in the sixth year of being studied and surveyed by selected geology and surveying students from Petersburg High School.

The students, using a helicopter and their own surveying equipment, are responsible for planning all necessary logistics, safety procedures, field notes, trigonometric computations and summarizing all data for submittal to the local media, University of Alaska (Dr. Will Harrison), the glaciology section of the U.S.G.S. in Tacoma, Washington, and the World Glacier Monitoring Service, Zurich, Switzerland. This research project has provided the participants with a practical application of science and mathematics, and the realization that they are contributing to basic science information hitherto unknown before the project began. Since the project began in 1983, Le Conte Glacier has advanced an average of 385 feet, with an average annual advance of 72 feet. A total of 29 selected male and female students have participated in this study since 1983.

# THE ROLE OF THE SERVICE LABORATORY, ALASKA AGRICULTURAL AND FORESTRY EXPERIMENT STATION, PALMER RESEARCH CENTER.

Rudy Candler, Agricultural and Forestry Experiment Station,
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The mission of the soil and plant analyses laboratory at the Palmer Research Center, Agricultural and Forestry Experiment Station, University of Alaska Fairbanks, is twofold. Analytical data are provided from the laboratory to individuals directly or through the Cooperative Extension Service, to researchers within the university system, and to state and federal agencies. The laboratory uses standard soil and plant analytical procedures to obtain information on the chemistry of plant tissue and soils. This information is used in compiling fertilizer requirements, feed ration formulations, and other recommendations for increased yields of crops, enhanced livestock production, or environmental quality.

Analyses performed for researchers enable them to advance knowledge in their respective disciplines. This knowledge may have immediate application in agriculture, natural resource management, and environmental programs through recommendations from the laboratory or from the Cooperative Extension Service. Thus, the laboratory provides a means for transferring research results to user groups.

# PROBLEMS AND SOLUTIONS: ROADS AND AIRFIELDS ON PERMAFROST

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Annual thawing and the related settlements of roads and airfields on permafrost often results in severe roughness and user discomfort. Frequent maintenance or total reconstruction of paved surfaces is necessary to provide an acceptable level of service.

The Research Section of Alaska Department of Transportation has evaluated a total of twelve instrumented road and airfield sections over the past 19 years, to study the problems caused by permafrost and massive ice in the foundation soils. At least ten different permafrost control treatment methods have been developed and tested at these sites, and conclusions have been drawn on what works and what does not. Forecasts for a global "Greenhouse Effect" warming, which is to have the greatest effect in the Northern regions, make the preservation of permafrost foundations a particularly difficult problem. Continuing thaw-settlement distress of roads and airfields is foreseen unless rather drastic and expensive permafrost control methods are used in new and reconstruction work.

## SCIENTISTS AND EDUCATORS WORKING TOGETHER

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During the summers of 1987 and 1988 I worked with a group of scientists studying an emergent grass that some day may be used to vegetate impoundments and wetlands resulting from road development on the North Slope of Alaska. There were five major benefits from this experience: 1) I gained a new appreciation for the metric system and can teach it with purpose to students; 2) I have found new resource people that can be called upon for advice and information as needed during the school year; 3) I have acquired slides and specimens for classroom examples; 4) my teaching strategy has evolved to teaching math and science skills to solve real problems; and 5) finally, I have acquired a first-hand appreciation for the Arctic environment.

Nineteen eighty-seven was a turning point in my classroom approach to teaching young minds. I have only touched on a few of the points to illustrate how the internship and work experiences affected my classroom teaching. I came away with many materials, photos, dried specimens and printed documents to use in the classroom, but most of all the field experience was an unforgettable part of me. I feel the summers were all-too-brief.

# MARINE SCIENCE EDUCATION: THE UNIVERSITY OF ALASKA MARINE ADVISORY PROGRAM

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The University of Alaska Marine Advisory Program is the public services component of the University of Alaska Fairbanks School of Fisheries and Ocean Sciences. It is a collection of specialists and agents who carry on a program which provides statewide informal marine education, serves as a link between the university and marine resource users, develops public awareness of resource management and conservation, and transfers new technology to those who will use it. The program has specialists in Aquaculture, Business Management, Fisheries, Seafood Technology, Seafood Quality and Media Production. Agents are located at Petersburg, Sitka, Cordova, Homer, Kodiak, Dillingham, Juneau, and Kotzebue. The overall goals of the program are to encourage the wise development, prudent utilization and considerate enjoyment of Alaska's marine resources. In general, those goals are met through research and education.

The Marine Advisory Program is divided into a series of missions which reflect the priorities established in the University of Alaska Fisheries Plan and reconfirmed in the Cooperative Extension Service six-year plan. MAP missions include Management, Response, Commercial Fisheries Development, Marine Safety, Fisheries Business Management, Seafood Technology, Aquaculture, and Marine Recreation. An extensive educational program in the subject areas covered by these missions is offered. It ranges from rapid response requests for technical information to formal courses, workshops, and lectures.

The basic personnel structure of the Marine Advisory Program consists of a team of specialists and agents. The specialists have regional responsibilities and travel to areas within the state to work on problems requiring their special knowledge. Field Marine Advisory agents are the interface with the public for a defined region. They are responsible for carrying out educational programs in their region and for identifying problems with which other specialists in the university should become involved.

Requests for information or assistance may come from government, industry organizations, or private individuals. The Marine Advisory Program has focused on providing educational and training opportunities to coastal Alaskans. Primary efforts are at present directed toward assistance to those who use Alaska's fisheries resources and to the area of marine safety. A new effort in the area of marine recreation has resulted in a separate mission for that activity.

The need for up-to-date technical information by Alaska marine resource users is compounded by their geographical isolation and the resulting logistical problems. Isolation in responding to requests for technical assistance, the program is increasing its use of telecommunication delivery.

Examples of Marine Advisory Program efforts in public education are: the "Sea Safety" video and textbook series on hypothermia, sea survival, shore survival, and coldwater near-drowning with two very recent additions on survival equipment and frostbite; the three-day Alaska Aquaculture Conference held in Sitka in November 1987; and the studies on economic contribution of commercial fishing and/or recreational fishing on the economy of Alaska's coastal communities.

# ENVIRONMENTAL EDUCATION AND PUBLIC AGENCIES:

## ALASKA PUBLIC LANDS INFORMATION CENTER RESOURCE EDUCATION PROGRAM

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Science education occurs in many informal settings outside of the traditional school classroom. Public land managing agencies depend on an informed and educated constituency who understand basic biological principles to support their efforts in properly utilizing the public resources. One strategy of agency science education is to provide interpretive facilities and educational programs for specialized groups and the general public.

The Alaska Public Lands Information Centers (APLICs) were created by an act of Congress with the passage of the Alaska National Interest Lands Conservation Act (ANILCA) to create a "system of information and education centers . . . to help provide visitors with meaningful, safe and enjoyable experiences and to encourage them to protect the fragile resources they will encounter." It was also the intent that the centers "should serve as a vehicle to stimulate environmental education in the local communities throughout the year . . . and serve as education centers for visitors as well as local public schools and university systems."

The Centers now in place (Anchorage, Fairbanks, Tok) provide a variety of educational opportunities - a destination for field trips with stimulating exhibits and media programs, environmental and resource education workshops for teachers and youth group leaders, resource curriculum workshops for use in the classroom and outdoors, speakers and programs for the field and classroom, consultation services for planning study units or programs, and support for community efforts in environmental education.

The eight sponsoring agencies can also utilize the Centers' resources to disseminate resource management information to the public about the agencies' goals and enlist the public's cooperation and support for proposed solutions to resource problems. For example at the Fairbanks APLIC, this summer's heavy Interior fire season was summarized and updated weekly in a small display accompanied by brochures that explains the Alaska Interagency Fire Management Plan and the rationale for allowing some fires to burn.

The APLICs through their education programs and interpretive displays can become a partner in encouraging the growth of a science literate public.

# KENAI FJORDS NATIONAL PARK, ALASKA; OUR ICE AGE HERITAGE IN THE HARDING ICEFIELD

**Bud Rice**
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The Kenai Fjords National Park was created in 1980 in the southern part of the Kenai Peninsula of south central Alaska. The park is near the town of Seward, so is easily accessible. Visitors to Kenai Fjords National Park can visit active glaciers and obtain information about them at a Visitor Center near Exit Glacier which flows from the Icefield.

Highlights of a slide presentation about glaciers presented to visitors include information about ice and water on Earth including unusual processes involving water such as geysering, snow flakes, icebergs, and glaciers. Photographs and satellite images illustrate the presentations. Because visitors are most likely to visit Exit Glaciers, photographs of it, measurements of glacier melting, snow density, and observations of local wildlife are presented. Relatively simple explanations are given to show the interactions between climate, glaciers, and sea level that have been discovered by glaciologists working in Alaska.

# VOLUNTEERS IN FIELD RESEARCH: A FORM OF SCIENCE EDUCATION

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Research support is ultimately dependent on public support — on a public perception that there is general societal benefit derived from support of research. It follows, both altruistically and pragmatically, that public education should be a responsibility of scientists. One form of public education can be found in use of volunteer assistants in field research. The Institute of Northern Forestry has over the past decade utilized volunteers, often students, in field tasks ranging from study of moose browsing in Denali Park to seed collection in forest genetics research.

More recently INF entered into a formal volunteer contract with The Center for Field Research, based in Watertown, MA, in a program termed EARTHWATCH. In 1987 and 1988 EARTHWATCH volunteers worked as field research assistants in the Caribou-Poker Creeks Research Watershed, 45 km north of Fairbanks. Volunteers (37 in 1987, 41 in 1988) ranged in age from 17 to over 70; in occupation from teacher to housewife to public administrator to systems analyst; in education from high school student to Ph.D. Volunteers have come from all corners of the U.S., and even from Italy and Australia. Volunteers were assigned to two-week *"teams"* (five teams per summer) of five to 11 persons. Each team worked with INF scientists and technicians. Tasks included streamflow measurement, stream sampling for water quality analysis, vegetation mapping on long-term reserve sites, individual tree biomass determination, and trail maintenance. A particularly interesting project was complete terrain and vegetation mapping and hydrologic monitoring of a series of pingos (ice-cored geomorphic features) in the Research Watershed.

While our primary objective in using volunteers is to accomplish field work, there is a strong *"public education"* aspect of this EARTHWATCH-Alaska Watershed program. Close day-to-day involvement of volunteers with scientists in the field provides opportunity for lay persons to develop appreciation of techniques employed and problems encountered in field research. Volunteers have learned that field research entails tedious, laborious data collection, often in the rain, surrounded by mosquitos and black flies: not glamorous! Another facet of *"education"* derives from use of guest lecturers at our EARTHWATCH camp in Caribou-Poker Creeks Research Watershed. We invited scientists, educators, and resource managers to visit, share dinner, and then present an informal discussion on their specialty. These talks and extended bull sessions offered volunteers a wide scope of subject matter and viewpoint, and expanded their Alaskan experience beyond the boundaries of the Research Watershed. Volunteers were also given a tour of the Poker Flat Research Range, and were encouraged to take advantage of other opportunities such as the University of Alaska Museum and the Alaska Public Lands Information Center.

We have no quantitative assessment of the *"educational benefits"* which volunteers gained from this program. However, unsolicited *"testimonials"* received from participants indicate that their awareness of environmental research, of Alaskan resource management questions and conflicts, and of Alaska's permafrost-affected taiga environment was markedly improved through participation in the EARTHWATCH-Alaska Watershed research program.

# ACID RAIN/ACID SNOW STUDIES IN THE ALASKA PUBLIC SCHOOLS

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This session is a short presentation followed by a question and answer period on the topic of Acid Rain/Acid Snow studies by Alaskan school students. Basic information and handouts on snow types, snow profiles and the Alaska Snow Surveys will be presented by an Alaskan teacher who is actively involved with 7th grade students in the collection of baseline data. Techniques of student participation and student activities will be included. Alaskans are on the cutting edge for making a difference in the quality of their air. The delicate arctic environment is at a critical stage, the beginnings of air pollution. Testing over the last five years has shown that the snows at North Pole are increasing in acidity. While not at a dangerous level, the environment is at risk. A data collection network for Alaska is being established by concerned teachers and students.

The recent drought in the lower 48 signals all Alaskans to be aware of their water supply. Most of the annual streamflow in the Western United States originates as snowfall. Hydrologists and students of North Pole Middle School measure snow water equivalents, precipitation, temperature and other parameters for the preparation of streamflow forecasting by the Soil Conservation Service and the National Weather Service. This is an exciting real world application of classroom learning and can involve students of elementary through high school ages.

## *Symposium IV*
## *HUBBARD GLACIER, RUSSELL FJORD AND SITUK RIVER STUDIES*

Chair: Larry Mayo
U.S. Geological Survey
Fairbanks, Alaska

# HYDROLOGY OF THE RUSSELL LAKE-OLD SITUK RIVER WATERSHED

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The advance of the Hubbard Glacier in 1986 created the worlds largest glacial dam lake by closing off the mouth of Russell Fiord. Had the ice dam held and Russell Lake continued to fill, runoff thru its historic outlet into Old Situk Creek would have resulted in significant changes to watersheds on the Yakutat Forelands near the village of Yakutat, Alaska.

This paper summarizes the results of hydrologic analyses conducted to predict the magnitude of potential Russell Lake overflow events should the Hubbard Glacier ice dam re-form at the mouth of the fiord. During the most recent event in the summer of 1986, weekly runoff into Russell Lake was measured at between 20,000 and 30,000 cubic feet per second (cfs). This runoff rate is roughly equivalent to 20 times the normal summer flow in Situk River and Lost River, the two principal streams that currently occupy the Old Situk River floodplain. Precipitation and watershed data were analyzed using two flood runoff models to predict potential peak runoff from the 723 square mile Russell Lake Watershed. Results indicate that extreme flood runoff events could result in lake overflows of a 50,000 to 75,000 cfs magnitude.

Russell Lake flooding will result in significant changes to channel morphology, water quality, fisheries habitat, and stream flow regimens in the Situk and Lost Rivers. These changes will likely result in adverse effects to existing sports and commercial fisheries, at least in the short term. Measures such as construction of flood diversion structures and removal of floodplain vegetation will be of little practical value in mitigating these impacts. However, there is good potential for development of fish habitat replacement projects such as rearing ponds and spawning channels.

# BEYOND MOUNT SAINT ELIAS

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The Yakutat, Situk, and Lost River Archaeological project was initiated in August 1986, in response to the advancing Hubbard Glacier and the resultant flooding of the Yakutat Forelands along the Situk River area. A three year program was begun to mitigate the loss of these nonrenewable cultural resources. This paper will present information on two of these sites; Shallow Water Town (Yak-020), and Diyaguna Et, (Yak-019) plus information on the Computerized Measuring and Recording System (CRMS).

The CRMS is an advanced archaeological mapping system, designed in response to this emergency. The CRMS collects the same information as the traditional archaeological recovery system but also incorporates the ease of analysis after the excavation. The main component of the system is an electronic Theodolite total station, which measures the three coordinates, X, Y and Z, automatically.

At present two sites (Yak-019 and Yak-020) have been excavated. On Lost River, site, (Yak-020) has been dated between 1760 A.D. and 1812 A.D. and has contributed information on subsistence activities, storage methods, and early historic Native Mortuary practices. Site (Yak-019) located on Tawah Creek is a 22 acre village site, which appears to contain a late prehistoric Eyak horizon and a late prehistoric/early historic Tlingit component. Preliminary analysis suggest this site may date as early as 1600 A.D., and shows a transition from an Eyak cultural horizon to a Tlingit horizon in the Yakutat area. The project has allowed, for the first time in Alaska, the analysis of Tlingit houses. The material of these inhabitants are represented by metal, both copper and iron for tools as well as chipped stone and a ground stone tool industry.

# Migration Timing, Size, and Salinity Tolerance of Sea-type Sockeye Salmon (Oncorhynchus nerka) in Situk River Estuary

by

Jonathan Heifetz, Scott W. Johnson, K V. Koski, and Michael L. Murphy

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To analyze the early life history of sea-type sockeye salmon (Oncorhynchus nerka), which migrate to sea as fry (age 0), migration timing, size, and salinity tolerance of age-0 sockeye were determined in the Situk River estuary, near Yakutat Alaska. Ten sites in three habitat types were seined monthly from late April through August, 1987, and age-0 sockeye from the estuary were tested for salinity tolerance. Age-0 sockeye were most abundant (up to 13/$m^3$) from late April through June, and by late July, most sockeye had left the estuary. Mean fork length (FL) was 31 mm in April and increased 0.4 mm/d to 70 mm in late July when most (72%) remaining sockeye had grown to about the same size as age-1 smolts (80-95 mm) emigrating in May and June. Mean FL of age-0 sockeye in the estuary in July was 11 mm greater than in freshwater areas of the river, indicating sockeye grew faster in the estuary than in the river. Salinity tolerance was directly related to fish size, and a size threshold of about 50 mm was required for survival in seawater. Because salinity in the estuary ranged 0-30‰, sockeye of all sizes could survive in the estuary. Thus, estuarine rearing enables sockeye to grow large enough to adapt to seawater and migrate to sea as fry.

# HISTORY OF RUSSELL FIORD AND HUBBARD GLACIER, ALASKA

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*Geologic evidence and human observation indicate that Russell Fiord near Yakutat, Alaska, has been the site of a glacier-dammed lake at least four times during the past 7,000 years. The radiocarbon ages of two varved lake deposits interbedded with till and glacio-fluvial deposits are 6,310 ± 110 years and 4,890 ± 100 years. Ethnographic history of Tlingit Indians of Yakutat includes information about one or more glacier-dammed lakes in Russell Fiord; a large river flowing from it, the Situk River; and an outburst of the lake about 1860 A.D. In 1986, Russell Fiord was temporarily dammed by Hubbard Glacier, but burst out into Disenchantment Bay before it overflowed into the Situk River. The peak discharge from Russell Fiord in 1986 was 105,000 cubic meters per second, which is the largest known outburst during this century.*

Moraine deposits of Hubbard Glacier indicate that it advanced to the mouth of Yakutat Bay in 1130 A.D. ± 130 years, retreated, advanced to the head of Yakutat Bay about 1700 A.D., and retreated. Since first mapped accurately in 1895 by the International Boundary Commission, Hubbard Glacier has re-advanced to the entrance of Russell Fiord by moving a protective submarine moraine into the body of water. This advance is expected to continue and form another ice dam across the fiord entrance.

# SITUK RIVER FLOOD PLAIN ANALYSIS

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The author has written a report describing the reconnaissance hydraulic analysis was made of the historic 17 mile Situk River channel from the Russell Lake overflow at an elevation of 131 feet to the Pacific Ocean. Aerial photo interpretation was used to develop a river profile and 26 cross sections. Reservoir storage routing using an assumed lake inflow hydrograph was used to develop flood peaks in the overflow channel. Channel routing of the floods was used to produce inundation maps for flows of 10,000 and 50,000 cubic feet per second (cfs). The results indicate low flows of 900 cfs and maximum peak flows of approximately 50,000 cfs. Channel locations are shown on aerial mosaic.

# JUVENILE SALMONID DISTRIBUTION, ABUNDANCE, AND HABITAT UTILIZATION IN THE SITUK RIVER

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Juvenile salmonid distribution, abundance, and habitat utilization were determined in 16 study reaches from June-August 1987 in the Situk River drainage. This study was initiated to obtain baseline data for estimating potential effects of Russell Lake flooding by the Hubbard Glacier on juvenile salmon in the Situk River drainage. Study reaches were selected from different channel types based on the Stream Classification System that categorizes stream reaches by hydraulic regime, geomorphic characteristics, and adjacent vegetation. Coho salmon were the most abundant and widely distributed juvenile salmonid in the Situk River and comprised approximately 80% of the total number of salmonids. Density to coho salmon was generally greatest in B and L channels and least in C channels. Sockeye salmon occurred in only about half of the study reaches and were all fry. Sockeye were primarily found in L channels and in the spring-fed C1.5 channel type (Old Situk River). Steelhead parr were primarily distributed in B1.6 and C channels. Dolly Varden char occurred in all but two study reaches. Chinook Salmon were absent from all study reaches in 1987. In 1988, 30 study reaches were sampled and chinook salmon were present in all mainstem Situk reaches.

## *Symposium V*
## *PORCUPINE CARIBOU HERD*

This session will include some talks on and a discussion of recent information on the Porcupine caribou herd in the ANWR. Formal talks will be on caribou ingestion rates of lichens, natural caribou body condition, and effects of pipeline corridors on caribou. The discussion will be moderated by Dr. Robert White, University of Alaska Fairbanks; Scott Robertson, ARCO Alaska; and Don Russell, Canadian Wildlife Service.

Chair: Robert White
Institute of Arctic Biology
University of Alaska Fairbanks

# SIMULATION OF LICHEN INGESTION RATES FOR THE PORCUPINE CARIBOU HERD BASED ON SEASONAL CONCENTRATIONS OF CESIUM-137 IN RUMEN CONTENTS AND SKELETAL MUSCLES

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The Porcupine caribou herd was monitored for cesium-137 during 1987 to address human health concerns over potential meat contamination by radioactive fallout from the Chernobyl accident, and to determine lichen intake rates based on body burdens of radiocesium. A total of 36 caribou were collected from northwestern Alaska and the Yukon Territories in March, June, September, and November. Radiocesium concentrations were comparable among muscles from the neck, shoulder, loin, and hindquarter, and peaked in March at 133 Bq/kg fresh weight. These values should not prove hazardous to human health. Radiocesium concentrations in skeletal muscle ranged from approximately 22 to 50% of radiocesium concentrations in rumen contents, and from approximately 15 to 37% of radiocesium concentrations in feces. Radioactivity in feces was significantly correlated with radioactivity in rumen contents. Simulation results for lichen ingestion rates are presented for 2 scenarios: 1) when seasonal intakes were adjusted to provide the optimum fit between simulated and observed radiocesium body burdens, and 2) when seasonal intakes were based on empirical data.

# MONITORING THE EFFECTS OF THE ENDICOTT DEVELOPMENT PROJECT ON CARIBOU

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The goal of the 1987 caribou study for the Endicott Development Project Monitoring Program was to assess the effectiveness of crossing structures in facilitating movements of caribou across the project pipeline corridor during the insect season (25 June - 31 July). Sampling methods included observations from towers in three study plots encompassing crossing ramps, observations from road surveys along the pipeline corridor (15 km), and areawide observations from aerial surveys of the Sagavanirktok River Delta. Overall, 690 groups totaling 10,823 caribou were observed from towers and during road surveys. Of 229 disturbance events (defined as locomotion in response to a disturbing stimulus), 80% occurred within 100 m of the pipeline corridor, often during attempted crossings. Vehicles were the primary stimulus in 78% of the disturbance events. We observed 106 caribou in 17 groups using the three ramps as crossing sites, constituting 18% of all individuals and 21% of all groups observed crossing in plots. Ramps were used significantly more than was predicted by their relative availability, but they did not substantially augment crossing success in "experimental" subplots, as compared with "control" subplots. These results are consistent with previous studies indicating that ramps are preferred but not required for crossing. Overall crossing success for groups approaching within 400 m of the pipeline in study plots was 39%; individual success was 11%. Both measures were greatest when the traffic rate was $\leq$14 vehicles/h. Crossing success determined from road surveys exceeded that observed in plots, probably because of paralleling movements through plots by caribou that eventually crossed. Thus, overall group success was 64%, and individual success was 44%; due to the sampling method these are minimal estimates. Aerial surveys documented influxes of caribou north of the pipeline corridor during insect harassment, followed by movements out of the area when insect activity subsided. We concluded that caribou generally succeeded in gaining access to insect-relief habitat north of the corridor; those that were unsuccessful in crossing reached coastal insect-relief habitat east of the corridor.

# ESTIMATION OF BODY CONDITION OF FREE-RANGING CARIBOU *IN VIVO*

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The need to monitor body condition of free-living animals in studies of reproductive success has prompted a reevaluation of existing techniques for estimating body composition and the development of new methods. In caribou (*Rangifer tarandus granti*) changes in live weight and body fat content are being estimated in radio-collared females that are periodically relocated and tranquilized.

Accurate determinations of body weight are made with a spring scale and tripod or helicopter lift. Body fat is assessed *in vivo* by estimating a) back fat thickness combined with a measurement of the fat content of a biopsy sample from the loin (*longissimus dorsi*) and b) the size of the body water pool (BWP) using tritiated water (HTO). The estimation of body fat relies on empirical correlation of the back fat and muscle fat indices with total body fat, while the BWP is inversely related to total body fat. Although the HTO technique yields a more precise estimate of total body fat, its utility in the field is limited by the time required for the injected dose of HTO to equilibrate with the BWP. In separate studies in fall, winter and spring, equilibration time ranged between 2 and 3 h. The single dose of M-99 and Rompun maintained the animal quiet but alert; however, in all cases deep body temperature rose by over 3°C, which has serious implications for reproductively active animals, particularly those that are pregnant. We recommend that future research focus on testing drugs that do not produce hyperthermia and on finding BWP markers that equilibrate more rapidly than HTO.

## *Symposium VI*
## *ADVISING HIGH SCHOOL TEACHERS AND COUNSELORS ON ENGINEERING*

This session will describe the type of things engineers do for a living, called the practice of the profession. This is to provide a background as to what is required of the incoming students. Few other curricula require the start of preparation in the high school and, in some cases, the grade school. The need for high school instruction for the incoming engineer in mathematics, English and the sciences will be presented by the people who have to meet this problem every day. The rate of growth of knowledge has been described as doubling every four years. This places the Engineering Schools, its faculty, and its students at a tremendous disadvantage. Generally, the UAF students are knowledge sops, but they need support before they get here. They need good study habits, and the backgrounds that only you can give them. We expect that you will have questions that we might be able to answer. If we can't, we will find out and get the response to you.

Chair: Vince Haneman
School of Engineering
University of Alaska Fairbanks

## *Symposium VII*
## *ANCSA:*
## *LOOKING AHEAD TO 1991*

This session is directed to Alaskan teachers and will examine the Alaska Native Claims Settlement Act (ANCSA) in the Context of the 1991 amendments passed by the U.S. Congress. The original ANCSA legislation will be reviewed and tribal and corporate perspectives on the 1991 amendments presented. The Fairbanks North Star Borough School District will provide a status report on the availability of ANCSA curriculum materials currently available. Successful techniques for teaching ANCSA will be discussed and audience participation encouraged.


Co-Chair: Terry Haynes
Alaska Department of Fish and Game
Division of Subsistence
Fairbanks, Alaska

Co-Chair: Linda Green, Coordinator
Alaska Native Education
Fairbanks North Star Borough School District

## *Symposium VIII*
## *ALASKA EDUCATION USING TELECOMMUNICATIONS*


Co-Chair: **Ron Inouye**
**Elmer E. Rasmuson Library**
**University of Alaska Fairbanks**

Co-Chair: **Steve Smith**
Elmer E. Rasmuson Library
University of Alaska Fairbanks

# TELECOMMUNICATIONS AND ALASKA'S PUBLIC SCHOOLS

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Beginning in the early 1970s the State of Alaska undertook a very substantial effort to take advantage of advances in telecommunications and computing technologies to attempt to overcome some difficult, long-standing problems it faced in delivering public services. This effort occurred in the context of addressing general public concerns related to telecommunications such as universal telephone service and accessing commercial and public radio and television. The general efforts and the specific programs for K-12 education were intertwined, initially to the benefit but, ultimately, to the detriment of the educational programs.

The educational programs were funded by both the U.S. Department of Education and the State of Alaska. When the programs were in full operation they served as national models for educational technology. Alaska received national and international attention for its innovative and ambitious programs. For almost 15 years the programs were responsible for providing a great deal of technical assistance, hardware, and software to schools in the state. Much of the focus was upon assisting small, rural schools to address the issue of equity of educational opportunity. It was reasoned that in many areas technology offered potential as a potentially cost-effective means to provide service to rural students that otherwise would be difficult or even impossible to provide through traditional means.

Unfortunately, with the collapse of oil prices in early 1986 and the concomitant fall in State revenues, the programs were some of the first items to be discarded in the panic that ensued in passing a reduced budget for FY87. What did these programs do? Why were they discontinued? What did their discontinuance mean for public schools? What options exist for the State and for public schools in the future?

These questions are addressed in this paper. Future directions are discussed for telecommunications and technology development in Alaska.

# K-8 SCIENCE CURRICULUM IMPROVEMENT USING CD-ROM

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This session will introduce the use of CD-ROM technology to access a thousand inquiry science lessons from NSF projects. A powerful search system allows rapid and selective use of lessons through criteria such as grade level science processes, subject, vocabulary words and content themes. Workshop session will include introduction of the CD-ROM technology.

# AN INTERACTIVE DIGITAL GRAPHICS NETWORK IN NORTHWEST ALASKA

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"Interactive digital graphics" is the exchange of graphics between computers connected by modems. The "interactive" feature allows the users to modify the graphics with a light pen or other input device; for example, change the net step in an algebraic equation, or point to some feature of a circuit diagram on-screen. Interactive digital graphics (IDG) allows people to communicate over a graphic image.

Chukchi College, in northwest Alaska, has been using an interactive digital graphics network to teach remotely located village students. Centered in Kotzebue, the network extends outward over satellite-based long distance telephone circuits to 9 outlying villages. Students in the "Electronic Chalkboard" classes can participate by both voice and computer graphics. Pictures drawn or typed on one computer screen can be seen by all other participating sites, and any site can respond in kind. The IDG network has been used successfully to deliver courses in developmental mathematics and computer science.

Rural Alaska Native students experience chronic problems in making the transition from village high school to college. Among the problems facing rural students is mathematics; the subject has traditionally been a "gatekeeper" to Alaska Native student success in college work. By building effective classes over an IDG network base, Chukchi College has been able to turn student failure in mathematics into student success. Prior to the IDG network, about 70% of Chukchi students attempting mathematics classes did not succeed; after two years of using the network, the dropout rate has decreased to about 30%. These results must be used cautiously. The sample size at Chukchi College is small, and adjustments in delivery include many more factors than just the hardware base, including strong cross-cultural adjustments in pedagogy. Nevertheless, the Electronic Chalkboard system has provided a communication opportunity which did not exist before.

There are over 200 rural schools in Alaska, most in non-road-connected villages. The village schools are small and have difficulty providing a full range of courses to their students. The majority of Alaska Native students are educated in those small schools. Equal access to education is a significant social problem in Alaska. With continued development, interactive digital graphics technology could help to provide better learning resources for Alaska Native students. By continuing to improve the technology with a firm eye toward human need, IDG networks may prove to be a significant teaching tool in the near future for Alaska schools.

# A HUMAN RESOURCE DATABASE FOR DISTANCE EDUCATION

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Rural College
University of Alaska Fairbanks

Steve Smith
Elmer E. Rasmuson Library/ Media Program
University of Alaska Fairbanks

For years Alaska was a world leader in the development of programs and technology for distance delivered education. Although the past few years have brought drastic cuts to distance education systems and services, the state remains an active player in the field of distance education. Throughout Alaska are individuals with expertise in many areas of distance delivery; however, all too often communication among these people is intermitent or non-existant. Programs and services are developed in isolation; efforts are duplicated; knowledge is not shared and built upon. In short, there is no mechanism in the state for staying current on who is doing what, where, and how to contact one another.

We propose the development of a Human Resource Database for Distance Education in Alaska. Among other information it would contain names, program and project descriptions, contact information, citations to related and relevant information, and expertise and interests of individuals. The database could be made available in a variety of formats, preferably on-line. It could serve as a catalyst for regular interaction among those involved in distance education in the state. At the very least such a database should enhance the work of all of us involved in this area of education, providing an opportunity for support and cooperation for all our individual efforts. This idea is at the earliest stage of development. Ideas and suggestions are both welcome and requested.

# DISTANT DELIVERY OF EDUCATION IN ALASKA VIA TELECOMMUNICATIONS

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This paper examines the history of distant education delivery via telecommunications in Alaska since 1971. It relates what was learned from the the Applied Technology Satellite experiments conducted from 1971 through 1976, the State of Alaska Television Demonstration Project and those efforts, such as the Open University of the United Kingdom, that were examined prior to and during the above experiments. It then relates the findings of the above experiments to the assumptions that were used by the University of Alaska and the Alaska Department of Education in establishing the Learn/Alaska Network in 1980. It then traces briefly the history of Learn/Alaska and offers some assumptions on the reasons for its decline in the period 1984-88. It closes with a brief examination of distant education systems successfully operating in North America and offers some reasons for their apparent good health at present in contrast to the decline of Learn/Alaska.

# DISTANCE DELIVERED INSTRUCTION: LEARNING FROM THE PAST . . . BUILDING FOR THE FUTURE

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Over the past 10 years, individuals within the University of Alaska have been involved in many aspects of distance education planning, development, and delivery. While some efforts have been successful, others have met with limited success.

Too often, promoters of distance delivered instruction do a disservice to both faculty and students by minimizing the planning, time, and effort it takes to effectively plan, teach, and learn via distance education.

This presentation will provide an historical overview of University of Alaska efforts related to distance education and will summarize strategies that can lead to more successful implementation of distance education programs.

## *Symposium IX*

## *PROGRAMS AND PERSPECTIVES IN ALASKA NATIVE SCIENCE AND EDUCATION*

Chair: David Norton
Institute of Arctic Biology
University of Alaska Fairbanks

# IMPROVING TEACHER PREPARATION PROGRAMS AT UAF THROUGH SCHOOL DISTRICT AND UNIVERSITY PARTNERSHIPS

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This presentation will examine some of the ways in which teacher preparation programs at the University of Alaska Fairbanks are attempting to respond to the special needs of students, teachers and schools in rural and urban Alaska by developing partnerships with school districts across the state.

Current and proposed partnership programs are designed to respond to the needs of two groups: 1) Alaska Native students who are interested in the field of education; and 2) non-Native students who intend to teach in rural Alaska.

At the present time, only 3% of the teachers in the state are Alaska Native, and although the number of Alaska Native freshman interested in becoming teachers is growing, there continues to be a large number of students who do not remain to graduate. Of special interest to this conference is the fact that only a small number of Native students in education choose to major in math or science.

Last year over 50% of the students in the UAF on-campus Education Department indicated that they are interested in teaching in rural Alaska, but the turnover rate for the non-Native teachers in these areas continues to be very high. Therefore, those involved in teacher preparation need to develop programs which attract and support Native Alaskan students in secondary math and science programs as well as in elementary education, and at the same time they need to develop programs that more adequately meet the needs of non-Native teachers who wish to teach in rural areas.

UAF has made efforts to respond to these needs by developing the new College of Rural Alaska and by supporting efforts to encourage new and expanded school district and university partnerships. The most encouraging and interesting of these partnerships include the following: 1) Rural Alaska Honors Institute; 2) "Orientation to Alaska Native Education" - a newly developed seminar and fieldwork course for freshman education students; 3) expanded opportunities for classroom experiences in the sophomore "Introduction to Education" class; 4) development of a post-baccalaureate certification-only program; and 5) increased opportunities for student teaching in rural schools.

These programs are providing students with opportunities for early classroom experiences, and this has encouraged and allowed students to more successfully integrate the worlds of theory and practice. Like the Rural Alaska Honors Institute model, the partnership programs promote an interdisciplinary perspective among students and teachers, and they provide specific cross-cultural training for students and faculty as they work with increasingly diverse groups of people.

The success of these programs depends on the degree of cooperation between school districts and the University, and hopefully this conference will provide new ideas on ways of improving this partnership.

# ETHNOSCIENCE: PERSPECTIVES ON NATIVE WAYS OF KNOWING

Ray Barnhardt
Oscar Kawagley
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This session will explore the largely uncharted terrain that lies between Western scientific tradition and the ways of knowing that have guided Native peoples representatives from both the Native and Western traditions pursuing a discourse on how the two traditions have evolved toward different views of the world, the implications of those different views for institutional practices and policy debates, and how the two views might eventually be reconciled with one another. Attention will also be given to the need for an Institute of Alaska Native Science to provide a forum for bringing Native scientific tradition and ways of knowing to bear on the problems humankind faces in attempting to unravel the secrets of the universe.

# THE RURAL ALASKA HONORS INSTITUTE 1984-1988: EVALUATION EFFORTS

Ann Frentzen
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Beginning with its second summer program, 1984, the Rural Alaska Honors Institute has each year included a formal evaluation component. This component has been developed and overseen by a full-time summer staff member hired specifically for this purpose. The purposes of the evaluation component have included gauging RAHI's success in meeting its academic goals, gathering data on student, staff and faculty reactions to the program, and identifying areas where programmatic changes may be called for. RAHI evaluation has included the gathering of both quantitative and qualitative types of data.

The quantitative aspects of evaluation center on a variety of pre- and post-student testing. This testing uses the Math and English ACT, the Nelson-Denny Reading Test, and pre/post tests developed by RAHI instructors for their individual courses. RAHI students are also asked to evaluate each of their courses and this evaluation employs a quantitative approach.

The qualitative aspects of evaluation have focused on gathering data not only from student participants but from faculty and dormitory staff as well. Each group completes a lengthy questionnaire at both the beginning and end of the RAHI program and faculty are also asked to fill out a one-page questionnaire at each of their weekly faculty meetings. In lieu of a weekly questionnaire, dormitory staff each meet with the evaluator once a week for a one-half-hour interview. The evaluator also conducts interviews with a selected sample drawn from the student participants. This sample includes approximately one fourth of the student participants and reflects the make up of the overall group by sex, academic ability, ethnicity, and geography.

Viewed as a whole, the data gathered over the last five summers presents a picture of a successful academic program for rural Alaskan high school students. Student participants, faculty, and dormitory staff, judging from their qualitative input, have consistently shared this view.

# INTERVENTION AS A MEANS TO IMPROVE COLLEGE READINESS OF RURAL ALASKA NATIVE HIGH SCHOOL STUDENTS: THE RURAL ALASKA HONORS INSTITUTE FROM 1982 TO THE PRESENT

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Within the past three decades, several intervention programs have been organized at the University of Alaska Fairbanks around the major goal of preparing Alaska Native high school students for college success. The Rural Alaska Honors Institute ("RAHI") was organized at the University of Alaska Fairbanks in 1982 at the request of Alaska Native leadership. The basic approach is to bring academically promising college-bound rural Native students who have finished their junior year in high school to the UAF campus for an intensive six-week academic program. Students with high grade point averages are recruited and brought to the campus to strengthen academic skills they already possess, to build a closely knit social and academic support group, to experience campus dormitory living and to get an introduction to college-style teaching.

The RAHI program has now hosted over 200 students recruited from over 500 applicants at the completion of its sixth summer session. Each student selected to attend RAHI is chosen for strong academic achievement, intent to attend college and demonstrated leadership at home.

The RAHI program maintains contact and support for its students as they return home to finish high school and as they enter and progress through college. UAF RAHI students participate in career-oriented summer internship programs with Native Corporations. They also may choose courses in current events featuring guest Native leaders and elders.

Overall the results of the RAHI program appear to be good although the full impact that it has upon the student is not easily quantified and not even always quantifiable. We do find that RAHI is a very visible and popular program within the Native community and participating school districts, and that it is a very popular program with both as well as with the students who participate. In examining that portion of the program's impact that is quantifiable, such as college "success rates", much is yet to be learned. We do see generally good academic performance and student retention by RAHI students who attend UAF as compared with that of a non-RAHI cohort of rural students, although the results are not spectacular but also not conclusive. As a tool of intervention we might tentatively conclude that RAHI is one of the "good" buttons to push in the face of any overall intervention strategy that dictates that all the buttons possible should be pushed in order to help minority students achieve college success.

# THE RAHI ETHNOARCHAEOLOGY PROJECT: AN EXPERIMENT IN SOCIAL SCIENCE EDUCATION FOR RURAL ALASKA HONORS STUDENTS

Howard E. Maxwell
Department of Anthropology
North Slope Higher Education Center
Barrow, AK 99723

During the summer of 1988, a new academic specialty course was introduced for RAHI (Rural Alaska Honors Institute) students, attending the Institute at the University of Alaska Fairbanks. The course, entitled "Ethnoarchaeology", provided an introduction to and overview of methods utilized in conducting archaeological and ethnohistorical research. Students learned both field and laboratory methods regarding archaeological investigation, and learned methods for conducting oral history interviews and research. Field training and instruction was split equally with classroom instruction. Classroom periods, stressed archaeological and ethnohistorical terminology and methodology.

The remains of an old semi-subterranean sod house on campus were investigated by the seven RAHI students who elected to take the course. The house was built during the late 1940's by Wendell Oswalt, a well known arctic anthropologist. He and his wife lived in the structure year-round for three years. It was subsequently occupied by another anthropologist, James Vanstone, during the early 1950's. The house eventually burned to the ground during Vanstone's occupancy. The structure itself was modeled after late prehistoric houses in the Kobuk River area which both Oswalt and Vanstone had examined during field research in that area. In addition to the work at the house site itself, students also participated in oral history interviewing with James Vanstone participating from Chicago via live audio-conference. Dr. Oswalt and Dr. Vanstone currently both hold prestigious positions within the field of anthropology. Dr. Oswalt is a professor at UCLA and Dr. Vanstone is the curator of the Field Museum of Natural History in Chicago.

The ethnoarchaeology project presented several unique opportunities and challenges for rural Alaskan high school students. First, it allowed rural Alaskans to see that social scientists (especially anthropologists) study many different kinds of problems and peoples — for a change, rather than rural Alaskan cultures be studied, a small slice of the life histories of two well-known anthropologists were being examined, a cross-cultural research problem with a twist. Research was to be directed towards the anthropologists rather than originating from them. The ethnoarchaeology course itself was designed so that after completing the course, students would have begun to obtain training in archaeology and oral interviewing — training which would allow them potential employment in the field of anthropology by having obtained minimal skills for participating in archaeological and ethnohistorical research projects in their own regions.

# MEETING THE NEEDS OF RURAL STUDENTS: THE RURAL ALASKA HONORS INSTITUTE MODEL

Gregory D. Moore
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-5285

The Rural Alaska Honors Institute (RAHI) is an intervention program for the purpose of academic enrichment of rural pre-college high school students. RAHI students attend an intensive 6-week academic session on the University of Alaska Fairbanks campus. Initial results indicate that RAHI has been successful in increasing rural student success in college.

Recognizing that no single educational strategy is likely to meet the needs of rural students, RAHI has informally coordinated its efforts with those of other UAF programs serving rural Alaska, including the University of Alaska Computer Network, the College of Rural Alaska, Rural Student Services (College of Liberal Arts), Alaska Native Studies (CLA), the Upward Bound Program (CLA), and many different disciplinary departments, including the Department of Engineering, the Department of Mathematical Sciences, the Department of Anthropology, and the Institute of Arctic Biology. Rather than recreating an entire set of academic services dedicated solely to the needs of rural students, RAHI has coordinated student contact with a variety of university services already in place.

By means of coordinating student contact with a variety of UAF services, RAHI has been able to put very good students in direct contact with very good teachers. Both students and teachers have experienced benefits from the coordination approach. Rural students have received instruction directly from professionals active in their fields, thus keeping the vitality, rigor, and relevance of instruction very high. Teachers, in turn, have been able to experience teaching to rural students as a group, and have learned valuable lessons about cross-cultural communication, student motivation, and student preparedness. The university community as a whole has benefited from these contacts.

The Rural Alaska Honors Institute may be a good model upon which to build future educational approaches to rural education. For example, the University of Alaska is examining many different technological options for distance delivery of instruction to rural students. Technological exploration of distance delivery is in keeping with current higher education trends in the United States and worldwide. The RAHI model suggests that coordination of pre-existing university teaching services over a technological base may be a good approach to future educational services for rural students.

# THE RURAL ALASKA HONORS INSTITUTE IN 1988: EXPERIMENTS IN ACADEMIC ADAPTATION

David W. Norton
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University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-7655

To keep pace with the improving quality of rural high school students' academic backgrounds, and to reflect better the sophistication with which undergraduate students are expected to develop their own academic schedules, RAHI instituted changes in 1988, its sixth year. These included the addition of two new academic specialty courses to make a total of six, the dropping of a required skills class in library techniques, a revision of the class schedule to link each student's specialty course to a course called team research and to a course in public speaking. Academic advising and tutoring were intensified for individual students whose academic achievements appeared to lag behind their potential.

The six academic specialty courses offered RAHI students in 1988 (Business, Engineering, Education, Ethno-archaeology, Natural Sciences, and Media-communications) provided a range of choices for the 46 students who entered the program. Class size ranged from 6 to 11 students, and all but 7 students were able to take their first choice among the courses offered. The connection of each speciality course with Team Research and with Speech courses meant that six pairs of RAHI instructors effectively team-taught the same group of students over a suite of three academic units for large blocks of time during the week. The combination of classroom, field work, library research, public speaking, and other activities around a thematic core gave both students and instructors a large degree of flexibility in time management during the weekday hours of 8 am and 5 pm. With neither library nor computer techniques courses being offered, it was left to these academic specialty course suites to find their own connections between content and skills. An early warning system for academic under-achievement was adopted, resulting in team counseling for five students, or about 10% of the student body.

The premium placed on time management and academic planning seems to have worked well in accelerating the self-reliance of RAHI students. Leaving computer and library techniques to the direction of content-determined course work produced mixed results. The rewards for early and intensive intervention with students having academic difficulties seem to have justified the effort. None of the 46 students was asked to leave RAHI this year, and without exception, they returned home with substantially improved expectations for their own success in higher education.

# OBSERVATIONS ON MATH READINESS OF RURAL STUDENTS AND ATTEMPTS AT IMPROVING THEIR RATE OF SUCCESS AT THE UNIVERSITY OF ALASKA, FAIRBANKS

Gregory J. Owens
Cross-Cultural Communications Program
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-6620

While the math abilities of students from rural Alaska who attend the Rural Alaska Honors Institute are improving, there is still a great need for developmental intervention. Such programs as RAHI attempt to meet this need at the high school level, and the Student Support Services grant faces the same challenges at the university level.

RAHI mean pre-test scores on the math portion of the ACT test have risen from a low of 10.92 in 1985 to 18.93 in the 1988 session. Post-test scores have risen an average of 2.2 points over the six week RAHI session. The 1988 mean post-test score of 20.30, the highest to date, would have placed the majority of students into credited math at UAF. But statistics show there is still a great need for developmental math intervention for rural students attending UAF.

The Student Support Services grant is implemented through the Cross-Cultural Communications program at UAF. Its target population is first-generation, low income students who need developmental intervention in mathematics and writing. The mathematics portion of the grant services approximately 75 students per semester through classes in elementary and intermediate algebra, and extensive peer tutoring. In addition, a peer mentoring program will be implemented this year. The goal of the program is to get students to a level where they can be successful in credited mathematics after two semesters of intervention. Early results have been encouraging, but further study needs to be conducted to assess the long-term success of the program.

# ENGINEERING SPECIALTY INSTRUCTION AS PART OF THE RURAL ALASKA HONORS INSTITUTE - 1988

Robert C. Speck
Department of Mining and Geological Engineering
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-6881

The primary objectives of the engineering specialty course were 1) to provide examples of the math, writing, information organization, and class/teacher interaction required of students in an engineering class and in the engineering profession at large, 2) to simulate the synthesis of diverse information and team effort commonly needed to produce a technical product, and 3) to present introductory technical information through lecture, reading, homework, and a term project. Ultimately, the last goal was the least important.

Classroom instruction centered around a team project. In order to accomplish the first two goals, and to address a problem common to rural Alaska, a team project was selected which addressed the geotechnical/groundwater problems inherent in the selection of sites for solid waste disposal. A hypothetical site north of Fairbanks was proposed and evaluated by the students. A standardized system for evaluating groundwater pollution potential was followed. This system, termed DRASTIC, was developed by the National Water Well Association and the U.S. Environmental Protection Agency to assist non-technical planners and managers. The information necessary for the site assessment was gathered in the field, presented by the instructor in class, and generated from topographic and geologic maps and library resources. Classroom instruction was tailored to provide the technical background necessary to understand all aspects of the DRASTIC evaluation system. Subject material included general geology, map usage, the engineering and geologic view of soils (including weight/volume problems), groundwater and permafrost. The students were then expected to weave this information into the DRASTIC system and produce, with the help of another faculty team-coordinator, a final report. The tasks of final report writing, project oral-presentation, and necessary mathematical calculations were incorporated into the writing, public speaking, and math portions of the program (instructed by the faculty team-coordinator).

Whether the experience of the engineering specialty portion of RAHI will produce any future engineers is unknown. Each student, however, experienced the integration of the many scientific, social, and other elements which are necessary for successful completion of most engineering projects. Problems in producing a final report included, difficulty solving problems which required the use of judgment as well as basic math concepts, organization of diverse information, and development of the initiative and team work necessary to bring the project to completion. Although many new technical concepts were presented over a short period of time and retention by students of specific information will probably be minimal, the act of participating in typical classes in engineering, the synthesis of diverse information into a final report, and the necessary interaction with other students provided each student with a valuable experience.

## *Symposium X*
## *SCIENCE EDUCATION*

Co-Chair: John Morack
Department of Physics
University of Alaska Fairbanks

Co-Chair: Helen Barrett
Fairbanks North Star Borough
School District
Fairbanks, Alaska

# SCIENCE EDUCATION INITIATIVE FOR THE 1990'S

Glyn Brice
NSTA Board of Director
District 4
Whitford School
P.O. Box 700
Beaverton, OR 97075
(503) 591-4550

In this session you will meet with your National Science Teachers Association Board Director to discuss the Science Education Initiative for the 1990's. NSTA has prepared the very important working document to resolve the problems which we face in education today. You will learn about the four interrelated initiatives that NSTA strongly recommends.

These are:

1. Teacher preparation and staff development;
2. Curriculum development;
3. Instructional support; and
4. Research and dissemination.

# Empowering the Adult Learner:

## The Teacher as Mentor

Don D. Bushnell, Ph.D.
Chair, HOD Program
Fielding Institute

Richard Applebaum, Ph.D.
Chair, Sociology Dept.

# THE NORTHERN STUDIES DIPLOMA PROGRAMME AT YUKON COLLEGE

N. Alexander Easton and Aron Senkpeil
Yukon College
Whitehorse

The Northern Studies Diploma Programme is an initiative developed by the Arts and Science Division of Yukon College. The Division currently offers students

# ASPECTS OF THE WORK OF M.C. ESCHER

George A. Escher
R.R. 1, Mahone Bay
Nova Scotia, B0J 2E0
CANADA
(902) 624-9413

A discussion with slides of mathematically oriented works by M.C. Escher,

...nections between them, and

# M.C. ESCHER AT WORK

George A. Escher
R.R. 1, Mahone Bay
Nova Scotia, B0J 2E0
CANADA
(902) 624-9413

A brief review with slides of the work of the Dutch graphic artist M.C. Escher. The emphasis is on his methods of work, his areas of interest and thoughts, particularly as they relate to his mathematically oriented prints.

# MATHEMATICAL MODELING: "APPLICATIONS IN BEHAVIORAL, LIFE, AND ENVIRONMENTAL SCIENCES"

**Martin Foster**
**Lathrop High School**
**901 Airport Way**
**Fairbanks, AK 99701**
**(907)456-7794**

This oral presentation on Mathematical Modeling is intended for high school Mathematics Teachers during the October, 10th Districtwide In-Service and in conjunction with the Arctic Science Conference. The presentation is designed for 90 minutes and the materials needed will include: an overhead projector, a chalkboard, and possibly an IBM computer with television adapter. It would be appreciated if this presentation and the one by George Escher were not scheduled at the same time.

This session is intended to introduce high school Mathematics Teachers to contemporary applications of mathematics in different areas of science, through Mathematical Modeling. Models concerning the AIDS epidemic and wild-life and human populations will be discussed based upon work completed this summer at the Woodrow Wilson Mathematics Institute for High School Mathematics Teachers.

# CROSS-CULTURAL COMMUNICATION IN ALASKA: PROBLEMS FOR MANAGERS, PLANNERS, AND SCIENTISTS

Thomas J. Gallagher
Division of Resources Management
School of Agriculture and Land Resources Management
Fairbanks, AK 99775
(907) 474-6930

About 20% of Alaska's 450,000 residents are Native Aleuts, Eskimos, or Indians. They own about 12% of the state. Their land is in relatively small tracts clustered around some 200 villages. Managers, planners, and scientists in Alaska, almost all of whom are non-Native, must interact with Native people as they study rural lands. Cultural differences often make this interaction difficult. Communication is often confused even though most Native people speak English. The problems stem from five differences: 1) in "world view" (or the assumptions about "what causes what"), 2) in the appropriateness of speaking about certain subjects, 3) in the manner of providing information and advice, 4) in the discourse pattern or communication style, and 5) in reading ability (particularly of scientific terms and administrative jargon). These differences lead to misunderstandings which in turn can lead to hard feelings. The situation threatens the cooperation and coordination needed to protect the resources of value to both Native and non-Native people. Proposed solutions include awareness by all parties of the sources of the problems and open discussion of the problems during communication.

# ALASKA SCIENCE CONSORTIUM PROJECT

Leslie Gordan
916 Reindeer Drive
Fairbanks, AK 99701
(907) 488-0134

Louise Ashmun
P.O. Box 204
Thorne Bay, AK 99950

This workshop will present a hands-on introduction to the Alaska Science Consortium Project — a process-oriented, teacher-based training model designed for K-8 teachers.

Piloted last June in an intensive three week summer institute, the Consortium focuses on science teaching which develops critical thinking and which capitalizes on use of northern ecological, earth and physical science concepts in the process. At the core of instruction is a learning cycle which is appropriate for either single-grade or multi-grade classrooms, meshes nicely with several national science curriculum programs and which reflects the generally continuous and cyclic process of doing science.

# MATHEMATICS EDUCATION FOR ELEMENTARY SCHOOL TEACHERS

Donald Greenberg and Ronald Seater
School of Education and Liberal Arts
University of Alaska Southeast
11120 Glacier Hwy.
Juneau, AK 99801
(907) 789-4540

Since so many elementary school teachers are deficient in mathematics and science, the National Science Foundation is trying to sponsor projects to remediate that situation. We believe that it is the responsibility of universities in Alaska to ensure that new teachers have the necessary mathematics background in the first place so they do not need to be reeducated later. We are proposing an approach we believe will reduce the need for remediating teacher deficiencies.

We will discuss the rationale for the mathematics we require of students preparing to be teachers through our campus. Our program requires that students pass a math competency exam prior to taking the math methods course. We will also discuss that exam and its role in teacher education. We want to encourage all Alaska universities to institute similar requirements in an effort to raise the quality of mathematics education in Alaska.

# SCIENCE EDUCATION OUTSIDE THE SCIENCE CLASSROOM

Carl M. Hild, M.S., Executive Director
Alaska Health Project
431 West 7th, Suite 101
Anchorage, AK 99501
(907) 276-2864

Students need to be encouraged to use and think about science in classes outside the normal "Science Class." Experience with two programs will be discussed. First, the development and use of the "'IF' and 'WHEN' Arctic Survival Manuals" as prepared by the North Slope Borough Health and Social Services Agency through a grant from the Northern Alaska Health Resources Association. Second, the use of the "Job Hazard Recognition Program" as developed by the Alaska Health Project through a grant from the Alaska Department of Health and Social Services Education/Risk Reduction Program.

Concepts and lessons from a variety of technical fields can be utilized to present topics in a fashion that enable students to both learn the point of the lesson, as well as to see a practical application of the laws of nature. Application to topic areas that are concerned with health seem to be ideal examples.

# STRATEGIES FOR THE PHYSICAL SCIENCE CLASSROOM

Elaine M. Jacobson

Department of Education

University of Alaska-Fairbanks

Box 80631 Fairbanks, AK 99708

(907) 479-2472

With current concerns about costs of chemicals and supplies and safety considerations when working with chemicals, teachers need to closely scrutinize the labs they use in their classrooms. Availability of materials in remote areas may also be a major problem. In this session, I will discuss approaches to keeping risks and costs under control while still keeping lots of hands-on student activities in the classroom.

Strategies will include miniaturization (reducing quantities of materials used), chemical substitutions (using safer/cheaper substances), and creative adaptations of readily available hardware and equipment. An underlying theme is our responsibility towards resource management and concerns for the environment.

Examples are drawn primarily from chemistry, but are easily adaptable for other science classes. Participants will have a chance to try some activities and will receive a number of handout

# ALL THE WRONG PLACES:
# HOW MANKIND'S ACTIVITIES CREATE AND DESTROY OZONE

Daniel A. Jaffe
Geophysical Institute
University of Alaska Fairbanks
Fairbanks, AK 99775-0800
(907) 474-7910

John Herring
Department of Chemistry
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-7525

The atmospheric chemistry of ozone is very complex. It is a greenhouse gas and plays an important role in the chemistry of the lower atmosphere. Ozone is also toxic to plants and animals at concentrations not far above present levels. Ozone is found in highest concentrations in the stratosphere where it acts to absorb much of the sun's ultra-violet light.

Unfortunately mankind's activities are seriously disrupting natural atmospheric processes. In the stratosphere, chlorofluorocarbons cause the accelerated destruction of ozone. A global decrease in the ozone layer of about 3-5% has now been observed over the past several decades, with losses most pronounced at high latitudes. This ozone loss is bad because ozone shields us from cancer causing ultra-violet light which would otherwise reach the surface.

In the troposphere, ozone concentrations are on the rise. Northern hemisphere ozone levels are rising by about 1-2% per year due to man's emissions of nitrogen oxides. This ozone increase does not compensate for the stratospheric losses, however, it does represent a significant concern due to ozone's toxicity and potential for climate change.

Predicting and understanding chemical changes in the atmosphere is one of the newest fields of science. There are a great number of uncertainties and opportunities for new scientists to address. In this talk an overview of atmospheric ozone chemistry will be given as well as a demonstration of our ozone monitoring instrumentation and "Los Angeles" smog chamber.

# THE IMAGINARIUM

Yvonne Merrill, Executive Director

The Imaginarium

725 W. Fifth Avenue

Anchorage, Alaska 99501

276-3179

The Imaginarium is the only interactive science learning center within Alaska. This presentation will concentrate upon the philosophy, the development, the process, the organization, and the future of this unique facility. This talk will include slides, and a question-and-answer session at the conclusion.

# DEMONSTRATIONS AND ACTIVITIES FOR LINEAR MOTION FROM A PHYSICS COURSE DESIGNED FOR EDUCATION MAJORS AT UAF

John Morack
Physics Department
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-6108

Jane Behlke

James Stricks
Center for Distance Education
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-6634

The authors have developed a special physics course* for education majors that will be distance delivered to rural villages in Alaska. The students who will be taking this course do not have an adequate mathematics background to meet the demands of a normal entry-level physics course. As a result, special materials, demonstrations, and activities have been designed which are non-mathematical and thus directly applicable to elementary and secondary classroom instruction. This presentation will examine the physical concepts associated with linear motion using these specialized materials. Materials and apparatuses will be provided for a limited number of people to allow participation in this presentation.

* This project is supported, in part, by the National Science Foundation, Grant #TEI-9552489.

# A MICROSCALE CONDUCTIVITY PROBE

Kathy Masley
Lathrop High School
Fairbanks, AK 99701

Have you ever wanted your junior high or high school students to test some solutions for electrical conductivity, but didn't have lots and lots of beakers with plugged into the wall sockets? Here's the answer - a microscale conductivity probe. This device enables you to test with a high degree of sensitivity the electrical conductivity of very small samples in a very safe and time efficient way. Come to this make and take workshop and go home with your very own tester; plus some activities.

# LAB SCIENCE AND MATH BY DISTANCE DELIVERY IN RURAL ALASKA

Maynard Perkins
Northwest College
Pouch 400
Nome, AK 99762
(907) 443-2201

The lab science courses; five math courses and one developmental math course for science majors developed and offered via distance delivery through Northwest College.

Study and lab guides were written for the science courses; lab exercises were modified to reflect the geographical location and culture of NWC students; lab kits containing instructor produced videotapes, computer simulated exercises, and other appropriate lab materials were put together. Classes are delivered via audioconference with additional student/instructor contact by telephone and computer.

The method of instruction for mathematics involves various combinations of instructor produced videotapes, computer assisted instruction, text assignments, and audioconferences. Arithmetic and algebra are offered as open entry/exit courses, while the mathematics concepts course is more structured, requiring audioconference class participation.

The study skills course is designed to provide students with skills essential for success in science course work and must be taken concurrently with a science course.

Of the 224 students enrolling in the classes, 52 have completed with a passing grade during the past three years.

# WRITING IN SCIENCE: IT WORKS

Jim Preston
Juneau Douglas High School
10014 Crazy Horse Drive
Juneau, AK 99801
(907) 586-3911

Incorporating the writing process in science class adds life and interest to science. It also gives students the opportunity to internalize what they have learned. I have found that the writing process is an excellent vehicle for changing a science class from one of learning about science to one of doing science.

I will present, in workshop style, several ideas, techniques, and activities which can be incorporated into nearly any science class. I have successfully used these activities in my middle and high school classes. I will provide several examples of student work.

The workshop participants will: set up and use learning logs; develop and use hypotheses; organize, analyze, and interpret collected data; and other activities found in a typical science class. The difference is that the writing process will be incorporated throughout the activities.

This is a *"hands-on"* workshop. The participants will be able to use appropriate ideas in their own classes the next day.

## ORTHERN CHILDREN

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# RADON IN ALASKAN HOMES: HOW TO DEVELOP PUBLIC AWARENESS

Richard D. Seifert
Extension Energy Specialist
Cooperative Extension Service
University of Alaska Fairbanks
Fairbanks, AK 99775-5200

In the autumn of 1986, radon gas was detected in several homes in the Fairbanks area of Alaska. Slowly and inexorably, the nature, geographical distribution and magnitude of the radon gas situation in Alaskan homes became apparent. As of May, 1988 over 400 homes in the Fairbanks area have been tested for radon, 52% of these homes contained levels greater than the EPA remedial action level of 4 piC/1. 20% of the homes tested had greater than 20 piC/1, which is the level at which uranium mines are closed because that is considered a hazardous level. One in five Fairbanks area homes tested exceeded this level. EPA estimates hypothesize that 5,000 to 20,000 lung cancer deaths per year result from radon and radon progeny in the homes of Americans. Add to this the revelation that the Fairbanks problem seems to be exacerbated by the local climate and our long winters, which imply a greater fraction of time spent indoors exposed to the radon gas and progeny, and the need for public awareness and concern is obvious.

The Cooperative Extension Service has been at the leading edge of a radon awareness effort which resulted from the early discovery of the radon problem. Educating people about the nature of the radon concerns, easing their fears and worries, both warranted and unwarranted, has been a focus of the education program.

Because radon is a concern which is almost entirely limited to private residences, it is beyond any normal public jurisdiction. This means simply that individual private citizens are the major clientele to reach, and they alone must be informed and supplied with rational alternatives for action, once the awareness of the problem develops.

Education is the primary tool in this process, and the educational awareness program about radon concerns in Fairbanks will constitute the bulk of this presentation. In addition, the potential for describing test procedures to school students and perhaps motivating them to test their homes will be discussed, because of the obvious opportunity for its application in the public education system.

# TELECOMMUNICATIONS AND COMPUTERS IN THE CLASSROOM

Steve Smith and Ron Inouye
Elmer E. Rasmuson Library
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-7224

This session will provide two demonstrations. The first will be the "Picture Phone," a telephone-like device which provides audio as well as freeze-frame video over a single telephone line. The demonstration between participants in Fairbanks, Anchorage, and Bethel will be led by Steve Smith of the UAF Rasmuson Library's "Distance Deliver" program. Peggy Cowan of the Alaska State Department of Education will demonstrate a Compact Disc (CD-ROM) product and identify National Science Foundation publications available for elementary and secondary science teachers.

# IMPROVEMENT OF ECONOMIC LITERACY AMONG ALASKA'S YOUTH

Monica E. Thomas
Fairbanks Center for Economic Education
School of Management
University of Alaska Fairbanks
Fairbanks, AK 99775-1070
(907) 474-6520 or 474-7119

A center for economic education was established on the Fairbanks campus in 1977. In 1985, it was joined by a center on the Anchorage campus. The purpose of the two centers is to improve economic literacy among Alaska's youth by increasing the quantity and quality of economics in K-12 classrooms. They are part of a nationwide network headed by the Joint Council on Economic Education, based in New York.

To accomplish the task of improving economic literacy, the two centers work primarily with teachers. They offer a variety of credit and non-credit courses, loan AV and written materials, and distribute micro-computer disks. They also assist the Department of Education and individual school districts in the development of economics curriculum, and coordinate a teacher incentive awards program.

As discussions progress toward development of a coordinated science education, and their policy making and fund-raising board, The Alaska Council on Economic Education, would be pleased to share expertise and experience.

# A HAZARDOUS WASTE CURRICULUM FOR ELEMENTARY AND SECONDARY SCHOOLS

Ellen Vande Visse
HC02 Box 7471-C
Palmer, AK 99645
(907) 745-0758

Funded by Solid Waste Services Department, Municipality of Anchorage, P.O. Box 196650, Anchorage, AK 99519, (907) 561-1906 (James Sweeney).

"Household Toxics" is a new curriculum and kit of experiments. It is developed by the Municipality of Anchorage to be placed in the Anchorage School District. Though aimed especially for 5th and 6th grades, the kit captivates junior and senior high level as well as adult citizen groups.

"Household Toxics" is designed for active, hands-on teaching. Part I emphasizes basic groundwater geology. Students conduct simple experiments with soil types and permeability. They predict, observe, record, compare, analyze, and conclude. Then students follow a red dye through a desktop groundwater model: they actually see how a hazardous chemical can form a plume and travel into well water.

In Part II, students do an inventory of household toxic products. They learn what hazardous means. They research what should be done with each product found in their house, and what safe substitutes to purchase in the future.

Workshop participants will learn:

— the basics of hazardous waste education
— how to run the experiments and models
— how to make their own kits
— how to obtain a written curriculum guide

INVENTIONS

Sue Yerian

Grade: Middle school (can be adapted K-12). The purpose of this workshop is twofold: to acquaint teachers with hands-on activities, books, magazines and other resources that can be used to begin or add depth to a classroom invention unit, and through teachers, to encourage student participation in the 1989 Invention Convention, which will be held in conjunction with the District Science Fair this spring. Each teacher will receive a packet of material containing ready-to-use student activities from a variety of sources, a teacher manual and application forms for the national INVENT AMERICA! competition. Teachers may browse through a collection of invention resource and activity books that have been purchased with funds from an FEA mini-grant.

# CLASSROOM ACTIVITIES FOR THE WINTER MONTHS: THE STUDY OF SNOW

Gerry Young
North Pole Middle School
North Pole, AK 99705

Don't leave the eight months of winter to sports, utilize the outdoor environment for field studies in a winter ecology context as well as earth and physical science activities.

Participants in this workshop will be introduced to a minimum of four activities designed for your classroom setting. Our activities will center on the study of snow (snow profiles, tracks, snow physics, snowflake castings).

Participants will gain an understanding of an overlooked and under utilized source of science education in the arctic.

## *Technical Session A*
## *PHYSICAL SCIENCES*

***Sections:***

1. *Global Change and the High Latitudes*

Chair: Larry Mayo
U.S. Geological Survey
Fairbanks, Alaska

Technical Session A
PHYSICAL SCIENCES

## *Section 1*

## *Global Change and the High Latitudes*


Section Chair: Larry Mayo
U.S. Geological Survey
Fairbanks, Alaska

Section Chair: Thomas Royer
Institute of Marine Science
University of Alaska Fairbanks

# COASTAL EROSION AND ACCRETION IN THE ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA: THE INFLUENCE OF SEA ICE, PERMAFROST, AND CLIMATE

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Coastline surveys, spaced 30 years apart, delineate patterns in erosion and accretion for more than 300 km of Alaska's Beaufort Sea coast in Arctic National Wildlife Refuge (ANWR). Delta shores are accreting at an average rate of 14.8 $myr^{-1}$. Bluffed coasts fronting the ocean erode on the average at 0.7 $myr^{-1}$; coasts fronting lagoons erode at only 0.3 $myr^{-1}$. Considering bluff height, ground ice content, and compensating profile changes out to 2 m water depth, the deltas have gained more than 17,000 $m^3km^{-1}yr^{-1}$ and the ocean- and lagoon-facing bluffs have lost about 5700 $m^3km^{-1}yr^{-1}$; the average loss for the whole coastline is less than 400 $m^3km^{-1}yr^{-1}$. The major factor limiting bluff retreat appears to be the presence of many barrier islands and shoals. Considering low bluff erosion rates balanced by marked delta accretion, overall ANWR coastal erosion is nearly an order of magnitude less than that reported in Harrison Bay, where lower river gradients decrease delta accretion and fewer barrier islands increase bluff erosion. For the short term, ice can help retard erosion by cementing coastal bluffs, however, thaw does not limit erosion for the long-term. Rather, the availability of mechanical energy and the effectiveness of ice gouging and ice push processes along with frazil- and anchor-ice transport may determine arctic coastal stability.

If the present rate of coastal retreat has been maintained since sea level approached its present position 5000 yr B.P., the coast has retreated 1.7-3.4 km and a large volume of offshore sediment has disappeared. Erosion probably extends seaward of the 2-m isobath because water depths at 1.7 km offshore are generally 10 m or more. No sediment sinks for the eroded sediments have been found along the coast or on the shelf, so most of the material eroding from the coast and inner shelf must be by-passing the continental shelf. Extrapolating delta-front positions back in time using present accretion rates suggests that the deltas expanded beyond the present coastline only in the last 200 years. A recent change in the rate of accretion, perhaps related to recent arctic warming, may be indicated. Warming would result in a deeper seasonal thaw of permafrost, thereby releasing more sediments to the river deltas. Warming could also cause more rapid erosion of ocean-facing bluffs as longer open-water seasons result in increased wave erosion of the shoreface.

# SURGE OF WEST FORK GLACIER

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In the early winter of 1987-88 the West Fork (Susitna River) Glacier began to surge, after a quiescent period of about 40 years. This surge has shown characteristics typical of others; disruption of the surface, sheared margins, 100 m or more draw down in the upper reaches, thickening in the lower regions, propagation of a fairly well-defined surge front, and copious production of suspended sediment that is obvious 250 km down the Susitna River at Gold Creek. More unusual about this surge is, first, the existence of a pre-surge data base on the flow and balance regimes of the glacier and on the sediment regime of the river, and second, an observational program that began early in the surge. The observational program has included both the glacier (where the evolution of the surface and the daily speed are measured), and the drainage system (where stage, turbidity and electrical conductivity are monitored near the glacier, and daily water samples are obtained downstream at 3 sites). The preliminary results will be described, and compared with those of the 1982-83 surge of Variegated Glacier.

# ANTHROPOGENIC WATER IN THE ICE FOG OF FAIRBANKS, ALASKA

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Ice fog is a common component of atmospheric pollution during the winter in Fairbanks, Alaska. Based on an inventory of water sources, it was estimated that 70% of the water making up this ice fog was from condensed meteoric water provided by evaporation from power plant cooling ponds and other anthropogenic sources, and 30% was from combustion of fuels. In the present study isotopic analyses for oxygen-18 and deuterium were made on ice fog samples, snow samples, and on samples of water from automobile exhaust. The results indicate that a minimum of about 15% of the water vapor in Fairbanks ice fog is created directly by combustion. For reasons cited, we believe the agreement between these two independent approaches is satisfactory.

# ATMOSPHERE-SEA ICE INTERACTIONS IN THE SOUTHERN HEMISPHERE

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Digitized sea ice and weather charts for the period 1973-1984 are used to examine the interactions between the atmospheric circulation and the Antarctic sea ice regime. In addition, satellite photographs from 1985 of Adelie Land are used in conjunction with surface maps and weather data from Dumont D'Urville to analyze a large scale ice movement event in that sector.

Results indicate that significant interannual variation in the ice edge position exists. Retreat in one sector is generally balanced by advance in another. Relationships between the latitudinally averaged ice edge position and the frequency, intensity, and position of cyclones are discussed. Since baroclinicity and thus cyclogenesis are strongly influenced by the presence of open water within the ice pack, polynya formation and persistence are examined.

Because oceanic effects on the sea ice such as surface shear stress and temperature advection are also important, these factors are included in the discussion. Possible correlations between El Nino-Southern Oscillation events and sea ice variation are also examined.

# BLUE HOLE(?) IN PEAR LAKE, YUKON TERRITORY OF CANADA

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Just before spring 1988 break-up, a brief inspection was carried out of an relatively large ice plated hole in the nominally flat bottom of Pear Lake in the Yukon Territory of Canada. Pear Lake, located near Old Crow, is a little over 1.5 kilometers wide by 3 kilometers long, but may be little more than a meter deep in most areas. The hole itself measured some 122 meters in diameter and was a little over 18 meters deep. At the time visited, an estimated 3500 liters of melt water was trickling into it each minute. Residents of the area flying over the lake in the summer time report that a whirlpool exists in the surface waters of the lake. Its existence is well known to natives of the Old Crow region.

The hole may be a karst feature in limestone which is known to exist in that general area. This may prove to be a terrestrial blue hole, adopting the unofficial terminology of similar karst features that drain tidal waters within ocean shorelines.

# NITROGEN OXIDE CHEMISTRY IN THE ARCTIC TROPOSPHERE

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Atmospheric nitrogen oxides are primarily anthropogenic in origin. They play a critical role in photochemical ozone production and contribute to acidic precipitation. Measurements of ozone at Barrow, Alaska, and Resolute, Northwest Territories, indicate that ozone is increasing in the Arctic during spring and summer. It is also known that concentrations of aerosol nitrate (a component of nitrogen oxides) increase annually in the spring due to transport of pollutants from more populous lower latitudes (Arctic Haze). However, there is currently little data on other, potentially more important, nitrogen oxides in the Arctic.

A photochemical box model incorporating 73 reactions of 40 compounds has been developed to investigate the hypothesis that long–range transport through an Arctic Haze pathway brings nitrogen oxides to the Arctic during winter and spring, while local sources are seasonally important in some areas. Model results indicate that nitrogen oxide transport from lower latitudes occurs with no ozone production during the period November to February, while photochemical ozone production becomes important in March. In addition, transport during winter results in the formation of stable nitrogen oxide compounds which may contribute to ozone production after sunrise in the spring. Nitrogen oxide emissions from the Prudhoe Bay oil production facility appear to be important in the summer, when they are expected to contribute to the increasing ozone levels that have been observed at Barrow. These model results also provide information on the chemical processing of nitrogen oxides and can be used to guide future measurements. Measurements taken at Poker Flat, Alaska, during Spring 1988 and at Barrow, Alaska, during July–August 1988 will also be discussed and used to indicate the accuracy of these model predictions.

# OZONE IN THE ARCTIC TROPOSPHERE

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Tropospheric ozone is an important greenhouse gas and plays an essential role in determining the chemical nature of the troposphere. Ozone is also toxic to plants and animals at concentrations not far above ambient. In the northern hemisphere, tropospheric ozone levels have risen substantially in the past century due to large increases in anthropogenic nitrogen oxide emissions.

Tropospheric ozone data collected at Barrow Alaska and Resolute, N.W.T. displays a complex seasonal pattern which is unique to the Arctic. During spring and summer tropospheric ozone levels in the Arctic have risen 1-2% per year over the past several decades. An interpretation of arctic tropospheric ozone is given based on four influences: stratospheric injections of ozone rich air, long range transport of ozone rich air from lower latitudes, local photochemical production, and surface reactions with vegetation. During spring, the observed long-term increase in tropospheric ozone is due to the transport of air containing elevated levels of nitrogen oxides via an "Arctic Haze" transport pathway. During summer, the observed increase in surface ozone observed at Barrow, Alaska is believed to be due to the substantial emissions of nitrogen oxides from the Prudhoe Bay oil production facilities.

Our model results indicate that ozone production per unit of nitrogen oxide emission is most efficient in relatively unpolluted regions of the globe. This result has important implications for the Arctic and other remote regions.

During the summer of 1988, nitrogen oxide concentrations were measured at NOAA's GMCC site in Barrow, Alaska. Preliminary results of these measurements will be presented and used to evaluate our hypotheses concerning tropospheric ozone.



108

# PHYSICAL-STRUCTURAL PROPERTIES OF ICE CORES FROM HOBSON'S ICE ISLAND AND THE STRUCTURE OF THE EAST WARD HUNT ICE SHELF

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Hobson's Ice Island is the largest of the numerous ice islands that calved in 1982-83 from the East Ward Hunt Ice Shelf, northern Ellesmere Island, Canada. With a mass exceeding 700 x $10^6$ tonnes it is also the largest ice island known in the Arctic Ocean at the present time. To learn more about the vertical structure of the ice island and the ice shelf, four deep ice cores (38-42m long), including one drilled right through the ice-water interface, have been drilled since 1985. Ice core analysis has included measurements of liquid electrical conductivity, stable and radio-isotopes ($^{18}O/^{16}O$, D/H, $^3H$), ice crystal size and orientation, and ice density.

The oxygen isotope values are all in the range -34.6‰ to -24.1‰, and the conductivity values do not exceed 274.0 $\mu S.\ cm^{-1}$. This data indicates that the former shelf ice is composed of freshwater ice throughout its entire thickness. However, the freshwater ice is not all of the same type or origin. From the surface to a depth of 27-28m, the ice crystals are mostly equi-granular (mean grain diameter, 8.75mm) and have random c-axis orientations. There are also occasional lenses of coarse-grained lake ice (grain diameter max., 46.5mm) . The ice in this layer is referred to as iced-firn; a term used to describe ice at the surface of the arctic ice shelves that has accumulated by the partial thawing and recrystallization of the snowpack. Variations in the physical-structural properties of the iced-firn and the occasional lake ice lenses indicate two major periods of past ice accumulation at the surface of the ice shelf.

Unlike the grain diameter variations in the ice above 27-28m, those below this depth show stratigraphic continuity and grain size maxima (15-20mm) and minima (5mm) can be cross-correlated between the ice cores. Furthermore, the c-axis orientations are not random; the ice has both vertical and horizontal c-axis orientations. This layer of ice is believed to have accreted from freshwater flowing below the ice shelf from Disraeli Fiord. The presence of anthropogenic tritium in the ice at the bottom of the ice island and differences in the deuterium excess values of the upper and lower layers of the shelf ice support the concept of bottom accretion of freshwater ice.

# CONCEPTUAL MODEL OF THE SUBGLACIAL ENVIRONMENT, TERMINUS REGION, MATANUSKA GLACIER, ALASKA

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The subglacial hydrologic system interacts with variable thermal and physical conditions of the glacier bed to determine sediment entrainment, transport and deposition. Data from direct observation and in-situ measurement and interpreted from the products of subglacial processes indicate the importance of interconnected conduits, small cavities and tunnel systems in removing subglacial meltwater and sediments during summer. Fountains fed by these tunnels flow under artesion pressures. This system collapses and by mid-winter discharge falls to zero, depositing sediment subglacially. Decreased flow and temperature induce freeze-on of sediment and stagnant water to the glacier sole. Water pressures gradually rise as ground water flow continues through winter, reducing effective stresses in bed materials and increasing the susceptibility to deformation. Perennially frozen, ice marginal moraines are impermeable to ground water flow, locally creating higher basal water pressures and inducing ground water movement beneath the moraines. Ice marginal movement with an increase in the flow rate occur during late winter or early spring during minimum discharge, and probably relate to higher water pressures and reduced shear stresses at the bed resulting from the disorganized subglacial drainage system. Flow rates gradually decrease as increased discharge from meltwater and runoff re-establishes the conduit-tunnel-fountain system.

# WINTER CONDITIONS AND SUBICE PROCESSES OF THE TANANA RIVER NEAR FAIRBANKS, ALASKA

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Winter flow of the Tanana River near Fairbanks, occurs beneath an irregular ice cover in multiple subice channels that are separated and confined by deposits of frazil ice. Frazil deposits extend from the base of the ice cover to the river bed, and lie with their axes subparallel to flow, being inversely analogous to point or mid-channel bars. Their initial location and subsequent growth appear to be controlled by ice jamming, ice cover formation, bed topography, anchor ice growth, frazil ice production, and discharge. Subice channels branch to form a braided or anastomosing pattern beneath the ice cover. Their cross sections and hydraulics differ from one another with scour and armoring commonly characterizing the central parts of channels. Subice channels migrate by current-induced erosion and failure of frazil bar faces; eroded frazil may be redeposited downstream, resulting in bar growth. Channel migration appears most pronounced late in the season, just prior to breakup, as discharge and water temperatures increase. Frazil deposit stability is also reduced then by increasing intergranular water movement and subsequent formation of enfrazil conduits. Subice channels can enlarge rapidly during this erosional period, with channel migration possible due to scour beneath degrading frazil deposits.

# WOLVERINE GLACIER, SOUTHERN ALASKA;

# SURFACE ALTITUDE MEASUREMENTS SHOW CONTINUING GROWTH

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Ice volume increase has been measured since 1976 at Wolverine Glacier, in the Kenai Mountains of southern Alaska. This glacier growth is happening during a period of gradual terminus recession, and is due primarily to an increase in snow accumulation during a period of climate warming in the area. Altitude measurements of the glacier surface, made seasonally at three geodetically fixed points along the glacier centerline, show that the growth is continuing and its effects are propagating down glacier. Surface height changes of a glacier reflect the combined effects of snow accumulation, snow and ice melting, and glacier flow.

From 1976 to 1987, ignoring seasonal variations, the glacier thickened about 6 meters at site C, which is located centrally in the accumulation area, and 7 meters at site B, located near the equilibrium line. At site A, located low in the ablation area of the glacier, the surface first decreased about 4 meters in height, but has recently started to rise. A time delay response down the glacier, apparently related to ice flow, is indicated. Large increases in glacier height occurred simultaneously at all three sites in 1977, 1981, and 1988 due to very large amounts of snow accumulation. At the present time, most of the glacier is thickening and the slow recession of its terminus is expected to end.

# THE EFFECTS OF ATMOSPHERIC $CO_2$ AND GLOBAL CLIMATE CHANGE ON ARCTIC TUSSOCK TUNDRA

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Total global atmospheric $CO_2$ concentration is expected to rise into the next century. Moist tussock tundra on the North Slope of the Brooks Range, AK was exposed in situ to ambient (340 ppm) and elevated (680 ppm) $CO_2$ under otherwise ambient conditions. Leaf area and number per ramet and growing point, fruition rates, and growing point state (mortality, latency, vegetative, sexual) and production (branch or tiller) for seven common tundra species were monitored. Early season ecosystem response to elevated $CO_2$ was great and occurred within 3 d of exposure; homeostatic adjustment occurred within 3-4 weeks of initial exposure. The onset of ecosystem senescence (winter dormancy) was delayed by approximately 10 d under elevated $CO_2$. Mid-summer reciprocal switching of $CO_2$ levels in the seasonal treatments indicated a very fast (1-2 d) response to elevated or lowered $CO_2$. In a short-term experiment, the whole ecosystem light compensation point occurred at 42% of full sunlight at elevated $CO_2$ and at 60% full sunlight for ambient $CO_2$ treatments. Whole ecosystem dark respiration rates were lower (but not statistically significant) at elevated $CO_2$. These data indicate a marked potential for homeostatic adjustment at the ecosystem level to $CO_2$ and probably other physical factors.

# THE "HEALTH" OF ALASKA'S PERMAFROST

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Fairbanks, Alaska

Fragmentary evidence indicates that permafrost in Alaska has been undergoing a recent warming, since about the mid-1800's, and that the climate has also been warming during this period. The magnitude and regional distribution of these warming events are poorly known. Holes have been drilled in permafrost for the purpose of developing a long-term program to determine the thermal regime of permafrost in Alaska and its relationship to climate. While the data are sparse, the results indicate that the permafrost in the coastal areas of the North Slope and in the Arctic National Wildlife Refuge has undergone a warming of about 1.5 to 3 °C during the last century but has cooled slightly, a few tenths degrees, since 1983. In the area from the Yukon River north through the Brooks Range, the permafrost warming has been small or non-existent. Permafrost in areas south of the Yukon River to the Copper River basin near Glennallen has undergone a warming which still persists but it has not been possible to obtain accurate estimates of the duration and magnitude of this warming. However, the permafrost in this area is generally within a few degrees of thawing, and some of this permafrost is presently thawing! Permafrost that is thawing presents special problems for construction and other human activities.

# SOME PERSPECTIVES OF AN OPERATIONAL POLAR REGION WEATHER FORECASTER

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Several winter season meteorological elements will be discussed that are unique to Alaska, compared with those experienced across the contiguous 48 states. Emphasis is placed on the tremendous influence that Alaska terrain exerts on the State's synoptic climatology. In turn, individuals having access to Alaska climatology statistics develop a comfortable working knowledge of how topography influences weather on a local scale. Proficiency in this area, along with experience, are prerequisites to successful forecasting.

Specific topics discussed include prevailing types of wintertime upper level wind flow patterns over mainland Alaska and applications of 500 mb climatological control contour locations and their corresponding surface weather. In many ways, precipitation over much of Alaska is not produced by classical "Norwegian model" frontal systems found over the mid latitudes.

During the Alaska winter, diurnal temperature variations nominally inferred from climatological normals tables of first order stations north of 60° north latitude are not related to real weather. Also, the so-called "extreme winter climate" oft ascribed to the University of Alaska and Fairbanks area is in many ways a misnomer.

# ON THE VARIABILITY OF THE WIND STRESS CURL FIELD OVER THE NORTHEAST PACIFIC OCEAN

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Monthly surface pressure data from the Fleet Numerical Oceanographic Center are used to examine the spatial and temporal variability of the wind stress curl field in the Northeast Pacific Ocean. Geostrophic winds, wind stress, and wind stress curls are calculated between 45°N-57°N and 137°W-164°W on a 35 point grid spaced 3 degrees in both longitude and latitude. Smoothed wind stress curl data show significant variability in space and time. The curl generally decreases in magnitude from north to south, with values at 57°N 4 times those at 45°N. The sign of the curl is positive in the Northern Gulf of Alaska and decreases to near zero and negative values in the southeastern section of the study area. Variations in the curl field are zonally in phase west of 143°W, and longitudinally in phase between 45°N and 51°N and 152°W-158°W. The largest or near largest values of the curl occur at the peak of a monotonic increase at the end of the time series, south of 57°N and west of 140°W. These increases are not present elsewhere. A relatively strong annual signal is observed in the power spectra for the Northern Gulf of Alaska, with signal strength generally increasing towards the east. Further south an annual signal is also present, however the amplitude has decreased to approximately 10% of the northern signal. These annual signals do not increase in amplitude to the east. There is also evidence for fluctuations with periods greater than one year in the curl field. The frequencies of these variations will be examined, as well as the physical mechanisms that drive them.

# THE ROLE OF THE ALASKA SAR FACILITY IN GLOBAL CHANGE STUDIES

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The Alaska Synthetic Aperture Radar (SAR) Facility is a joint venture between NASA and the University of Alaska Fairbanks (UAF) to construct and operate a facility on the UAF campus to receive data from SAR satellites, and to process analyze, archive and distribute these data. The data have a variety of different uses but are particularly valuable in the emerging global change studies, which aim to assess the causes and effects of major global climatic changes, as triggered, for example, by the greenhouse warming of the atmosphere. Monitoring of the changes in sea ice and snow cover extent and characteristics as affected by climate changes, can be done particularly well with SAR which is not affected by clouds or darkness. Snow and ice extent have strong feedback effects on climate. Other possible applications are the assessment of glacier mass balances from SAR data, which can probably differentiate between wet and dry snow and can thus determine changes in the equilibrium line on glaciers. Melting glaciers raise the level of the world ocean, and the glaciers of the Alaskan coastal range have been major contributors to the observed sea level rise of about 20-30 cm over the last century. It may also be possible to determine changes in the permafrost regime, although the penetration of microwave in the SAR frequency range is still being investigated. Numerical models show the polar regions to have the largest climatic change due to the greenhouse effect, and the consequences of this to snow, ice, and permafrost should be very pronounced and detectable by satellites carrying SAR as well as other sensors.

# Radiation Climatology of Alaska

By
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Detailed radiation measurements were carried out at four locations in Alaska: Kodiak, Anchorage, Fairbanks, and Barrow. From Kodiak in the south to Barrow in the north, these stations span 13 degrees of latitude. One station is located in each of the four climatic zones; these are the coastal, transition, continental, and arctic zones, respectively.

Considering the substantial differences in latitude, the mean annual values of global radiation were amazingly similar for all four stations. The higher solar elevation in the south is compensated for by the longer summer days in the north. Furthermore, the clearness index, which is the percentage of extraterrestrial solar radiation which is transmitted through the atmosphere, was higher in the north than in the south. This holds true both for clear and for overcast conditions. For clear conditions this is explained by the cooler and therefore drier atmosphere over Barrow, which contains less water vapor, thus absorbing a smaller percentage of the radiation. For cloudy conditions, the difference can be attributed to cloud characteristics. The clouds are 'thicker' in the south, with many large droplets which absorb strongly. An indirect indication of this can be deduced from the amounts of precipitation in Kodiak, which receives more than 10 times the precipitation in Barrow.

Multiple reflection between the surface and the atmosphere (clouds) enhances the radiation, especially during times of high surface reflectivity (snow cover). This is especially pronounced in the spring at Barrow.

Other radiative measurements, such as the energy received on south facing slopes and walls, the direct solar radiation, and the sky radiation will be discussed. The effects of the El Chichon eruption, which took place in Mexico on 4 April, 1982, will also be discussed. The El Chichon eruption, whose effects were felt in Fairbanks some six months later, reduced the solar radiation for about two years before the values returned to normal.

# EDUCATION AND GLOBAL CHANGE IN THE GEOSPHERE

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As we approach the 21st century, there is likely to be an acceleration of change on the surface of the Earth and in its atmosphere in response to human activity. A scientifically literate citizenry must be capable of making informed decisions in order to deal effectively with these changes. A solid understanding of earth and space science is one of the prerequisites for a scientifically educated population.

Earth science is an integrated science that incorporates the principles of physics, chemistry, and biology, and the tools of mathematics and computer science into a historical view of the processes and changes that will likely affect our planet. Because of this broad perspective, earth science is possibly the most relevant physical science for achieving a better understanding of our local and global environment, and can give students a cohesive global perspective of the complex interrelations of the geosphere and biosphere. A comprehensive, challenging, and interesting curriculum in earth and space science is necessary to meet the national need for a scientifically literate and informed society in the late 20th and subsequent centuries.

# SPATIAL TRENDS IN NORTHERN ALASKAN SNOW CHEMISTRY

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Seasonal snow on Alaska's Arctic Slope stores wet and dry deposition throughout the winter. Thus, snow can assist in the identification of sources of natural and anthropogenic inputs to arctic watersheds. In this talk, the results of a study of northern Alaskan snow chemistry and the implications for sources of contaminants will be discussed.

24 samples were collected for chemical analysis along the Dalton Highway from the Yukon River to Prudhoe Bay (66°N to 70°N). In addition, 10 samples were taken along a 10 km traverse centered on and perpendicular to the Dalton Highway to identify the effect of this feature on snow chemistry. Samples were collected in clean polyethylene bottles and stored at -20°C until immediately before analysis.

The most striking feature of this work is that snow on the Arctic Slope contains more impurities than snow in the interior (approximately, by factors of 36, 3, 10, and 30 for $Cl^-$, $NO_3^-$, $SO_4^{2-}$, and $Na^+$ respectively).

The sources for impurities in Arctic Slope snow include sea salt, anthropogenic dust (ie road and construction dust), natural dust, local anthropogenic activities (ie. Prudhoe Bay), and distal anthropogenic sources such as Arctic Haze. The Dalton Highway in the vicinity of Toolik Lake appears to be a large source of $Cl^-$, $SO_4^{2-}$, $Na^+$, and $K^+$, but not a a source of $NO_3^-$. Since the enrichment of $NO_3^-$ in Arctic Slope snow may have important biologic implications, its possible sources will be discussed. Possible sources for other components in Arctic Slope snow will also be discussed.

## *Technical Session B*
## *SOCIAL SCIENCES*

***Sections:***

1. ***Current Themes in Arctic and Subarctic Social Science***

2. ***Peoples and Cultures of Southwest Alaska***

3. ***Contributions of the Social Sciences to Land Use Planning and Resource Management in Alaska***

Chair: Terry Haynes
Alaska Department of Fish and Game
Division of Subsistence
Fairbanks, Alaska

Technical Session B
SOCIAL SCIENCES

## *Section 1*

## *Current Themes in Arctic and Subarctic Social Science*

Section Chair: Terry Haynes
Alaska Department of Fish and Game
Division of Subsistence
Fairbanks, Alaska

# THE INSTITUTE OF CIRCUMPOLAR STUDIES: FOCUS ON "PEOPLES OF THE CIRCUMPOLAR NORTH"

Pauline Gunter

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The University of Alaska Fairbanks has embarked on a major new endeavor: The Institute of Circumpolar Studies. Each summer a multidisciplinary faculty team will conduct seminars on a selected humanistic theme. This year's theme is "Peoples of the Circumpolar North." Future Institutes will further expand on subjects affecting people of the north: education; scientific, political and governmental policy formation; health; or scientific and historical writing and modern literature.

UAF's Rasmuson Library Collections will be a central feature in this study of Northern Peoples and their environments. In order to do this we have established three objectives: to generate descriptive comparisons of different cultural groups, to promote multidisciplinary research, and to teach students specific skills to conduct systematic library research.

The Summer Institute is designed for an international group including graduate students in history, anthropology, geography, and political science; government workers; and rural and urban librarians and school teachers who wish to enhance their knowledge of the north. The participants' varied backgrounds will mix academic training with personal experience. Students may receive graduate credit for successful participation in the Institute, but credit enrollment is not required. This paper will present a critical evaluation of the first experimental Institute conducted August 1-5, 1988 and will discuss what we have learned from this session that may be incorporated into plans for future Institutes.

# NATIONAL PARK SERVICE RESEARCH DIRECTIONS IN THE ARCTIC

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Over the last five years the National Park Service has developed an active research program in the Artic, and subarctic, park areas, as a prerequisite to the responsible management of natural and cultural resources. Significant contributions have already been made, while a number of important projects are on-going or planned for the future.

Traditionally, National Park Service researchers work cooperatively with their peers to gather and share data on cultures and ecological communities within and beyond our park borders. These exchanges extend to national borders, as well. The Arctic with its fragile resources, continuity of cultures, and the potential for monitoring global change, is an ideal place for inter-organizational and international cooperation. We look for opportunities to establish common ground and undertake cooperative endeavors with the larger arctic research community.

# CONTEMPORARY SUBSISTENCE HARVEST DATA – BARROW, ALASKA

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Subsistence harvest data are currently being collected in the Alaska North Slope communities of Barrow and Wainwright. The data are an essential tool for future policy decisions, impact assessments, and in the resolution of land use conflicts. This paper briefly describes the sampling procedures, methods of data collection, and preliminary findings for the first of three years of research in Barrow. Emphasis is placed on the valuable contribution to the project made by locally hired research assistants. One positive result is a reciprocal educational experience for both the researchers and the research assistants. The study of Barrow and Wainwright residents' subsistence harvest activities is funded by the U.S. Department of Interior, Minerals Management Service with additional support provided by the North Slope Borough.

# THE ALASKA INTERAGENCY ARCHEOLOGICAL GROUP

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The Alaska Interagency Archeological Group (AIAG) held its first meeting on January 15, 1988. The group was formed under the sponsorship of the National Park Service Alaska Regional Office for the purpose of increasing communication and sharing of information among Federal and State archeologists in Alaska. The infant group has already become an important forum for professional communication and education, and the discussion of common problems. Topics addressed in past meetings include: how to improve the Federal archeology program; new technologies in archeology; the U.S. Arctic Research Plan and Federally funded research in the Arctic; and research questions that can be addressed with data from Pleistocene megafauna from placer deposits.

# AN ASSESSMENT OF CARIBOU HARVESTS IN KAKTOVIK, ALASKA: 1981-1987

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Caribou are an important food resource for residents of northern Alaska. Mineral leasing as well as exploration, development and production is increasingly occurring in caribou range and near communities on the Arctic coast. Increasing competition, access restrictions to former hunting areas, displacement of caribou and progressively more restrictive hunting regulations are conditions northern caribou hunters may be facing as a result. Particular concern over the long-term well-being of the Porcupine and Central Arctic caribou herds, and the people who depend on them, in the face of increasing industrialization in the central Alaskan Arctic and proposed lease sales on the coastal plain of the Arctic National Wildlife Refuge precipitated a long-term caribou harvest monitoring project. Data on overall harvest levels as well as sex composition of the harvest, harvest timing, herd affinity of harvested caribou, and harvest locations utilized by Kaktovik caribou hunters have been systematically collected since 1981. These data now form a solid quantitative baseline concerning local caribou use in the 1980's and provide high quality information essential for evaluating the impacts on subsistence use of the Porcupine and Central Arctic caribou herds associated with land status and land use changes in the eastern Arctic.

Findings to date indicate that harvest levels vary considerably from year to year and that harvests are biased toward bull caribou. The majority of caribou are harvested from late summer to late fall and then again in late spring. There is considerable variation in herd affinity of harvested caribou from year to year. Coastal harvest sites, most within the proposed ANWR oil lease area, have contributed half or more of the annual caribou harvest since the study began. These findings will be reviewed and discussed in the context of current land management planning in the eastern Arctic.

Technical Session B
SOCIAL SCIENCES

## *Section 2*

## *Peoples and Cultures of Southwest Alaska*

Recent investigations into the history of and adaptations and culture change in Southwest Alaska are providing important new information for scientists, educators, native groups, and policymakers. Brief reports on collaborative work between University of Alaska Fairbanks anthropologists and the National Park Service in the Lake Clark area, archaeological research in the Kodiak and Aleutian regions, subsistence research in the Bristol Bay area, ethnohistorical investigations elaborating both traditional social systems and contact history, and historic research on Russian Alaska illustrate the breadth of this work.

Section Chair: Jean Aigner
Department of Anthropology
University of Alaska Fairbanks

Technical Session B
SOCIAL SCIENCES

## *Section 3*

## *Contribution of the Social Sciences to Land Use Planning and Resource Management in Alaska*

This session will examine the contributions made by social scientists and social science data to land use planning and resource management in Alaska. Attention will be given to the types of social science data developed for use by state and federal agencies, as well as to the actual application of these data in the decisionmaking process. One goal of this symposium is to identify possible strategies for strengthening the role of social scientists in land and resource planning, management, and policy in Alaska. Participants in this symposium will include social scientists, state and federal agency representatives, university faculty, and administrators.

Section Chair: Terry Haynes
Alaska Department of Fish and Game
Division of Subsistence
Fairbanks, Alaska

# CROSS-CULTURAL COMMUNICATION IN ALASKA: PROBLEMS FOR AGENCY SCIENTISTS, PLANNERS, AND MANAGERS

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The Native people of Alaska — Aleuts, Eskimos, and Indians — comprise about 20% of the population. Through their corporations, Alaska Natives own about 12% of the land area, most often as relatively small tracts in a matrix of federal and state holdings. Both Native and agency interests in the land and land resources requires clear communication between Native people and agency scientists, planners, and managers. Four problems inhibit this communication: 1) Native people are overloaded by the complexity of agency programs and plans, 2) the "world view" of Native cultures does not readily accept Western concepts of planning and management, 3) the public meeting used by agencies is an inappropriate forum for involving Native people, and 4) subtle but significant differences in communication style complicate discussions between Natives and non-Natives. Proposed solutions include simplifying and coordinating agency programs and plans on a regional basis, using forums for communication that are consistent with Native tradition, and increasing awareness of differences in communication style among both Native and non-Native people.

# SUBSISTENCE, TECHNOLOGY, AND WILDERNESS: VALUE CONFLICTS IN ANAKTUVUK PASS

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The Chandler Lake Exchange, executed in 1983 by the Arctic Slope Regional Corporation (ASRC) and the U.S. Department of Interior, created a difficult policy issue. Prior to the exchange, Native villagers living in Anaktuvuk Pass used all-terrain-vehicles (ATVs) to hunt caribou migrating through mountain passes in the central Brooks Range. After the agreement, 103,000 acres passed from ASRC ownership to the National Park Service, and was to be managed as part of the Gates of the Arctic National Park and Preserve. To protect its wilderness values, the federal managers sought to limit ATV travel for subsistence use to specific corridors, and the villagers responded with considerable anger.

An analysis of the policy problem created by the land exchange must deal with three interrelated concepts: subsistence, technology, and wilderness. The first involves subsistence values, in that hunting caribou provides the Nunamiut people (inland Eskimos) with needed food and links them with a cultural tradition that is thousands of years old. The second concept relates to advances in travel technology over difficult terrain, and how the use of ATVs has become important for villagers in pursuing a subsistence lifestyle. The third idea involves wilderness values, and the effect that ATV use for caribou hunting has on the quality of those values. This includes the ecological integrity of the land and the state of mind sought by recreationists who visit federal lands legally defined as wilderness.

The ATV issue in Anaktuvuk Pass represents a unique situation where two national interests appear to be in collision. On the one hand, preserving some federal lands in a wilderness condition, free from intrusion from machines, is seen by Congress as a worthy value. On the other, the cultural survival of Alaska Natives is also considered a value of national importance. In this particular case, the all-terrain-vehicle appears to have forced these national values into political conflict with each other. This paper analyzes the conconflict between subsistence and wilderness generated by a new technology.

# THE APPLICATION OF SUBSISTENCE INFORMATION IN MANAGING FISH AND GAME IN ALASKA

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This paper discusses how scientifically-gathered subsistence use information is used in decisionmaking about fish and game management in Alaska, such as setting bag limits, determining open seasons, and allocating limited stocks between user groups. The state management system routinely uses scientific information to achieve mandated biological goals (escapement and sustained yield) and social goals (reasonable harvest opportunities to different user groups). The application of scientific information in specific cases typically involves a complex negotiation process between different interest groups. Particular decision outcomes are affected by social, political, and economic issues as well as biological concerns. This paper describes recent management decisions about the salmon fishery along the Togiak, Kanektok, and Goodnews rivers as a case example of how subsistence use information was used by the State in a negotiation process between interest groups to arrive at a fishery regulation.

## *Technical Session C*
## *ENGINEERING AND ENGINEERING EDUCATION*

***Sections:***

1. *Alaska's Engineering Education: Its Future*
2. *Engineering Research*

Chair: John Zarling
Department of Mechanical Engineering
University of Alaska Fairbanks

Technical Session C
ENGINEERING AND ENGINEERING EDUCATION

## *Section 1*

## *Alaska's Engineering Education: Its Future*

This session will include a keynote address, followed by speakers offering a variety of perspectives — private engineering consulting, the Governor's Office, the university's governing board, a telecommunications specialist, and the deans of Alaska's three schools of engineering. The keynote address will be given by Frank G. Turpin, President and Chief Executive Office, Alaska Railroad Corporation, who will review some of his past experiences in both private industry and government, especially as related to the adequacy of preparation of young engineers. Mr. Turpin will comment on the need for continuing education for engineers as they develop in their profession. Following the keynote address, the other members of the forum will offer reflections on the address and suggest how Alaska's engineering education should meet the state's needs in the 1990's and beyond.

Section Chair: Leroy Hulsey
Department of Civil Engineering
University of Alaska Fairbanks

# CONTINUING ENGINEERING EDUCATION
# USING STATE-OF-ART SATELLITE TECHNOLOGY

Bob Merritt

Professor Emeritus-Electrical Engineering

University of Alaska Fairbanks

The School of Engineering at the University of Alaska-Fairbanks, (UAF) is participating in a unique nationwide education program, the National Technological University (NTU). Twenty four associated universities are presently equipped to transmit (up-link) televised graduate level engineering courses to over 140 receiving (down-link) locations. Students registered in NTU can get an accredited graduate degree in Computer Science, Computer Engineering, Electrical Engineering, Engineering Management and Manufacturing Systems Engineering.

The receiving locations are usually located at the work site of a group of participating engineers. Last fall, over 1200 students were enrolled in degree programs. Over 20 people have now received their masters degrees from the NTU program.
The NTU distribution system is satellite-based using the G-Star satellite operating in the Ku band, (12/14 GHz). The classroom programs are up-linked to the satellite and received at each organizational site of participating graduate students.

The network is operated from the NTU Control Center in Denver, Colorado. Professor Larry Bennett, Head of the Engineering and Science Management Department of the UAF is the chairman of the Student Advising Committee for NTU's Engineering Management Program.

Technical Session C
ENGINEERING AND ENGINEERING EDUCATION

## *Section 2*

## *Engineering Research*

Section Chair: David Spell
Department of Electrical Engineering
University of Alaska Fairbanks

136

# INSTRUMENTATION TO INVESTIGATE THE EFFECTS OF GEOMAGNETICALLY INDUCED CURRENT (GIC) ON THE ALASKA INTERTIE

John D. Aspnes, B. David Spell and Robert P. Merritt
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University of Alaska Fairbanks

Geomagnetic storms not only cause visual displays but also induce electric currents in grounded conductors such as the trans-Alaska pipeline and electric power transmission lines. These relatively low frequency currents are often a sizable component of excitation current in power transformer windings and can produce half-cycle saturation. Nonlinear transformer action results with a consequent generation of abnormal harmonic current and voltage products and protection relay misoperation.

The Alaska intertie, an electric power transmission line connecting Anchorage and Fairbanks utilities, has been instrumented to determine the effect of GIC on transformer real and reactive power requirements, transformer audible noise and protective relay circuits. The instrumentation is based upon a personal computer which has been enhanced with a signal processing peripheral and a tape recorder. Twenty one analog channels of data from certain sites on the intertie are analyzed and recorded at a one second sample rate.

In addition, three channels are sampled at a nine hundred Hertz sample rate. These data are Fourier transformed in real-time and the harmonic information contained in those spectra are recorded for later analyses.

# ELECTRON BEAM EXPERIMENTS FROM THE SHUTTLE ORBITER DURING THE SPACELAB-2 SHUTTLE MISSION

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Electron beam experiments are conducted in space for a variety of purposes, ranging from geophysical investigations to the study of basic plasma processes. One such experiment was the Vehicle Charging And Potential experiment (VCAP) which has flown on two Shuttle missions: STS-3 in 1983 and Spacelab-2 in 1985. The prime objective of this experiment was to investigate the electrodynamic interaction between the Shuttle Orbiter and the ionosphere during electron beam emission. A Fast Pulse Electron Generator (FPEG) emitted an electron beam from the payload bay of the Orbiter with beam currents of 50 or 100 mA, resulting in the charging of the Orbiter and a flux of neutralizing return current from the ionosphere. Diagnostics of the charging and return current were provided by a combined Charge and Current Probe (CCP) located in the payload bay of the Orbiter. The CCP measurements were used to conduct a parametric study of the vehicle charging and return current as a function of vehicle attitude, ambient plasma parameters, and emitted beam current. The CCP measurements were also profoundly affected by the operation of the Orbiter's reaction control thrusters. This experiment resulted in a better understanding of the process of electron beam emission from a spacecraft in the ionosphere. Many of the same instruments will be re-flown as part of the Shuttle Electrodynamic Tether System (SETS) experiment currently manifested for a 1991 Shuttle flight.

# APPLICATIONS OF DIGITAL IMAGE PROCESSING TO PHOTOELASTIC STRESS ANALYSIS

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In the study, a two-dimensional transmission photoelastic model of underground chambers was utilized to simulate changes of the stress field around openings in response to pillar crushing, room span increase and roof fall. A model of multiple underground chambers was constructed by cutting four equally spaced rectangles on a PSM-1 photoelastic sheet. The photelastic material was loaded uniaxially and stress concentrations created as a result of the openings were simulated and photographed. Throughout the experiment, the center pillar of the model was constantly modified to reflect a possible support failure or roof fall which might be encountered during the construction of an underground power plant, underground storage chamber, or other general subsurface geotechnical excavations.

The photographs of the fringe patterns were then scanned by an Eikonixscan 78/99 camera. The digitized fringe images were processed by computer to better locate the constant stress fields under different engineering conditions. Among the processing routines utilized, it was observed that the gradient method, which determined the changes of local radiometric variability of the fringe patterns, produced better images for the comparison of stress changes under various excavation conditions.

# PLATE-LOAD TESTS OF PERMAFROST SILT AND GRAVEL IN THE FOX PERMAFROST TUNNEL

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In order to obtain information on the deformation characteristics of permafrost silt and gravel typically found in the Fairbanks area, long-term plate-load tests were performed on these materials in the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) permafrost tunnel in Fox, Alaska. Ten-inch and 12-inch diameter steel plates were placed on permanently frozen silt and incrementally loaded over 20- and 11-day periods respectively. An 18-inch diameter steel plate was also used to test the frozen gravel section of the tunnel over a 21-day period. All tests were conducted well into a secondary creep stage of deformation.

Results from the testing program include deformation and strain versus time curves for each material under various loads, bearing pressure versus strain rate information for each material and isochronous curves of each material at different durations of loading time.

# THE HARDWARE IMPLEMENTATION OF THE SYNTHETIC APERTURE RADAR (SAR) PROCESSING ALGORITHM FOR THE ALASKA SAR FACILITY

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University of Alaska Fairbanks

The Alaska SAR Facility (ASF) is being delivered in three modules. The first, the receiving and ground station has been installed. The third module, the archiving and operating system (primarily software) will be delivered in late 1989. The second module, the Alaska SAR Processor (ASP) is currently under construction at the NASA/CalTech Jet Propulsion Laboratory (JPL) in California.

The synthetic aperture of SAR systems is formed through complex and computer intensive data processing techniques. To date, all SAR processing systems have been implemented on main-frame type systems. Because of the relatively large volume of data in a scene and the multiple correlation/convolution and data rotation and compression operations that must be performed, the time and expense to process a scene is prohibitive to on-line processing.

In the ASP, the processing algorithms were all implemented in dedicated hardware. It is implemented as a hybrid system of chip-level designs with a mini-computer interface. The ASP is designed to operate on-line at one-quarter "real-time" and, as such, will be the fastest SAR data processor in the world.

# SELECTING POWER CONDITIONING EQUIPMENT FOR ESSENTIAL LOADS AND SENSITIVE ELECTRONICS IN RURAL ALASKA

M. Wilson, J.D. Aspnes, R.P. Merritt and B.D. Spell

Electric power disturbances are known to be more prevalent in small, isolated power systems than in interconnected grids which service larger communities. Within limits, small utilities strive to deliver clean, well-regulated AC power to their customers. However, with transmission lines exposed to the severe Arctic climate and the switching on and off of various customer loads, the utilities actually have limited control over power quality.

As the present trend in rural Alaska is toward increasing numbers of computers and sophisticated electronic equipment, various types of power conditioning devices are being applied in an effort to safeguard against data loss, component degradation and catastrophic equipment failure. "Power conditioners", voltage regulators, UPS, high isolation transformers and surge suppressors constitute the bulk of equipment which is commonly used to protect sensitive loads from powerline disturbances. It is important to understand the operating principles and limitations of each of these devices as well as the electrical requirements of essential loads when considering the power conditioning alternatives. The improper application of a protective device may reduce or completely eliminate its effectiveness.

# DIRECT STABILITY ANALYSIS FOR SOIL SLOPES USING FINITE ELEMENT TECHNIQUE

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Most slope stability analyses for soils assume a circular failure surface. In this study, the failure surface in model slopes was directly determined based upon the stresses induced in the soil mass and the strength of the soil itself. The state of stresses of various slopes was estimated by ADINA (Automatic Dynamic Incremental Nonlinear Analysis) finite element program with the Drucker-Prager nonlinear material model. The Mohr-Coulomb failure criterion and Mohr's circle stress analysis were, then, applied to the resulting stresses as determined by ADINA in order to locate any potential failure surface.

The model soil slopes containing failure surfaces as determined by this method were analyzed utilizing Sarma's method, a general method of limit equilibrium analysis, and found to have factors of safety close to 1.0. A set of stability diagrams are presented using the results of this method. With these stability charts, factors of safety of slopes can be defined. The advantage of this method is that the location and shape of a failure surface can be now directly determined without the assumption of a specific failure surface geometry. Iteration process is, however, required to define the stability diagram for a slope of interest.

# RURAL FACILITY ELECTRIC POWER QUALITY ANALYSIS

Y.Q. Zhao, J. D. Aspnes, R.P. Merritt and B.D. Spell

The electric power qualities of two isolated power systems in Alaska are analyzed. The analyses cover several types of power system disturbances. They are: impulse, sag, surge, frequency fluctuation, overvoltage, undervoltage, power failure, power demand and power factor. The data are recorded by using a Dranetz Series 626 Universal Disturbance Analyzer and a Dranetz Series 808 Electic Power Demand Analyzer at each site. Data are periodically transferred for analysis via a telephone data link and the University of Alaska Computer Network (UACN) to an IBM PC-XT computer located in Fairbanks. Statistical analyses of these data have revealed several characteristics of the two power systems and will serve as a base for further power quality analyses at these two sites. The combination of these preliminary results and those resulting from the remainder of this project will be used to define areas in which electric power quality may be improved, either by system modification or by power conditioners utilized where necessary to protect sensitive electrical loads.

## *Technical Session D*
## *MATHEMATICS, STATISTICS, COMPUTER SCIENCES*

Chair: Gary Gislason
Department of Mathematical Sciences
University of Alaska Fairbanks

145

# DEPENDENCE OF VIBRATIONAL AND ROTATIONAL YIELDS IN IRRADIATED MOLECULAR HYDROGEN ON FRACTIONAL IONIZATION

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Previous calculations of yields of electron irradiated molecular hydrogen have provided a fairly complete picture of the initial response of the gas. The general calculational procedure consists of assembling a complete set of inelastic cross sections and then using this cross-section data as input for numerical solution of the appropriate Boltzmann equation. Solution of the equation gives a quantity closely related to a distribution function. This quantity, the total track length, is then used along with individual cross-sections to calculate the absolute yield of each excited state of the gas.

Recent studies indicate that the number of vib-rotational existed states in molecular hydrogen produced by the impact of low-energy electrons (sub-excitation elections) in some cases far exceeds the number resulting from cascading. These studies were performed for the pure gas and did not consider instances where an accumulation of free electrons exist. Since these results are already in use for construction of models of interstellar clouds, extension of the calculation to include free electrons is necessary since the fractional ionization in some regions of the clouds is expected to be as high as $10^{-4}$.

We have modified the previous calculation by including the electron-electron energy loss rate in the total stopping power over the range (0, 8.8eV). We will discuss the calculational procedure, the new features introduced by inclusion of this process, and present preliminary results of the calculation.

# RECENT RESULTS AND EXAMPLES IN SPLICING SYSTEMS

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The concept of a *splicing system* was introduced by Tom Head at the 1984 Arctic Science Conference as an abstraction of the process of restriction enzyme digestion and subsequent religation of DNA molecules. Additional properties of splicing system languages were presented by the author at the 1985 and 1987 Arctic Science Conferences. The fundamental property studied has been that, for restricted classes of splicing systems, the languages thus generated are regular, in fact, strictly locally testable.

Some recent examples will be presented which show that not all splicing languages are strictly locally testable nor even non–counting. Also, the following will be discussed:

**Theorem:** Every regular language is a homomorphic image of a splicing language.

The theorem is proven by showing that the class of languages which can be represented as a homomorphic image of a splicing language is closed under union, concatenation, and Kleene closure, so by Kleene's Theorem, contains all regular languages. In contrast, an example of a regular language which is not a splicing language will be given. Finally, some examples will be presented which demonstrate the difficulty encountered in attempting to extend the automaton constructions previously used to general splicing systems.

# THE FULLY TWO-DIMENSIONAL FLUX-CORRECTED TRANSPORT SCHEME

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To compute the shocks or the steep-gradient solutions to hyperbolic partial differential equations, $\partial\rho/\partial t + \nabla\cdot(\rho v) = 0$, the technique of flux-corrected transport was developed by Boris and Book, which produces stable, positive, mass-conservative and eventually second-order accurate results in the one-dimensional case. Using the same requirements of mass-conservation and positivity, a fully two-dimensional algorithm is built by the two-step procedure of fully transporting the flux on the x-y plane and then correcting the flux. The computation shows that this fully two-dimensional algorithm yields realistic and accurate results in handling the shock problems. A discussion of the total variation diminishing (TVD) property related to FCT is also presented.

# VOTING POWER AND PRESIDENTIAL ELECTIONS: ONE MAN, 3.143 VOTES

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Voting occupies a central place in democratic practice and provides a fascinating arena for mathematical analysis. In the 1960s the U.S. Supreme Court enunciated the principle of "one man, one vote" which, despite a prominent justice's admonitions against dragging the law into "political thickets and mathematical quagmires," opened the way for the use of mathematical notions of voting power in legal arguments and judicial decisions.

Using elementary mathematical methods from combinatorics and game theory, we analyze the distribution of power in electoral systems, and study the comparative effect of individual voters from different states in U.S. presidential elections.

# GENERAL TOPOLOGY IN APPLIED ANALYSIS
# or
# WHY ALL GOOD DATA ANALYSTS SHOULD STUDY TOPOLOGY

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Students of applied mathematics know the power of complex analytic techniques such as conformal mapping and analytic continuation. Analytic/holomorphic functions are very well behaved, but subsets of the plane on which they live can be very unruly. In order to describe the interaction of these two elements, abstract methods of classifying sets must be used. This is general (or point set) topology.

We examine a specific case, the Identity Theorem, which settles the fundamental questions: What is the essential information sufficient to specify an analytic function? The answer is: The function values on a discrete subset of its domain. To be more detailed we must get topological.

# A MATHEMATICAL THEORY FOR AERIAL SURVEYS

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We address the problem of estimating the density per unit area of animals or objects from data gathered by aerial surveys. We present calculations in the case of the arctic loon, and conclusions from some Monte Carlo experiments. Observers flying in a straight line record the distances of the loons to the plane trajectory. These distances constitute the raw data from which to deduce the density of loons per hectare. This problem belongs to the category of line transect surveys for which a mathematical theory exists (Burnham, Anderson and Laake, 1978). The advantage of line transect theory is that "visibility bias" is accounted for automatically. Its application to aerial surveys presents two added problems: the speed of travel allows only the crudest estimate of sighting distances, and there exists a "blind strip" right below the plane. We propose a theory incorporating both features.

# Simulation of Color in Halo Phenomena

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*Mathematical Sciences Department*
*University of Alaska-Fairbanks*
*Fairbanks, AK 99775*

The variation in an index of refraction as a function of wavelength is termed *dispersion*. The colorful appearance of atmospheric phenomena, such as rainbows and ice crystal halos, is due primarily to the dispersive refraction of light by particles in the atmosphere. Previous simulations of halo phenomena produced achromatic intensity plots using ray tracing methods which ignored dispersion. This paper presents a *forward* ray tracing technique for modelling atmospheric refraction which incorporates the effects of dispersion into the refraction calculations. Using this method, realistic computer generated images can be created which accurately reproduce the coloration in observed ice crystal halos.

## *Technical Session E*
## *BIOLOGICAL SCIENCES*

***Sections:***

1. *Current Themes in Medical Research*
2. *Modern Ecology*
3. *Ecology and Quaternary Studies*
4. *Physiological Ecology, Behavior and Systematics*
5. *Applied Resource Management*

Chair: Lawrence Duffy
Department of Chemistry
and Institute of Arctic Biology
University of Alaska Fairbanks

Technical Session E
BIOLOGICAL SCIENCES

## *Section 1*

## *Current Themes in Medical Research*

Section Chair: Sven Ebbesson
School of Fisheries and Ocean Science
University of Alaska Fairbanks

# PROTOTYPE STANDARD POLLEN CALENDARS FOR ANCHORAGE AND FAIRBANKS

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Prototype standard pollen calendars are now available for Anchorage and Fairbanks. A standard pollen calendar is a composite of graphs showing for each aerial pollen taxon record high, average, and record low atmospheric concentrations for each day in the pollen season. The present calendars are considered prototypical because they are based on only six years of data, 1982 through 1987. More nearly representative calendars will require ten or more years of data because of great differences in pollen production and timing from year to year.

Standard pollen calendars are of ecological and biometeorological interest and summarize results from an important form of long-term environmental monitoring. Beyond this they are of much value to allergic persons, about ten percent of the population, and physicians because most airborne pollen is allergenic. They offer a certain predictability of pollen conditions for each day in the season when read in conjunction with current weather information. They show which pollen types are most likely to be causing allergy symptoms at any time. A predictability is offered also for annual pollen parameters. For pollen onset and termination, the time periods within which these will occur are indicated for each taxon. For pollen season severity, the calendars suggest a tremendous annual variability, while an interpretive text accompanying each calendar will explain how this parameter might be predicted several months in advance.

The pollen source vegetation is similar in Anchorage and Fairbanks, but there are notable differences in the aeroflora as shown by the pollen calendars. Allergenically Anchorage appears somewhat more benign than Fairbanks, but this is only a hypothesis at this point because only one sampler has been used in Anchorage. This, plus the residence of probably over 20,000 allergic persons in greater Anchorage demands an expansion of the program there.

Aerobiology research is also being conducted in Palmer, Juneau, and Whitehorse. Pollen calendars for these, and spore calendars for all locations, are planned.

# PREVALENCE OF ANTIBODY TO HEPATITIS A AMONG ALASKA NATIVES

Lisa Bulkow, Robert Wainwright; Arctic Investigation Laboratory;
Sue Anne Jenkerson, John Middaugh; Division of Public Health;
Brian McMahon; Alaska Native Medical Center

Hepatitis A infection has a worldwide distribution with a tendency for cyclic recurrences. Historically, this cyclic pattern has been evident in Alaska. Epidemics of disease were seen during the early 1960s and again during the mid 1970s, though not all regions of Alaska were involved in these epidemics.

Since the time of the last statewide epidemic, the pool of susceptible persons has been growing. During the fall of 1986, the State epidemiology office noticed a dramatic increase in the number of hepatitis A cases reported. In order to learn more about the size and make-up of the susceptible Alaska Native population, a sample of banked sera was selected to be tested for antibody to hepatitis A (anti-HAV). The sample consisted of 4,030 sera, stratified by age and community.

Statewide, an overall positivity rate for anti-HAV of 49.3% was found. This rate varied significantly across the state, from a low of the 35% in the Anchorage region, to nearly double that in the Yukon-Kuskokwim Delta region. The prevalence of anti-HAV increased with age from 6.3% among persons born since 1976, up to 86% among those born before 1946. Patterns vary among regions, reflecting paths of previous epidemics.

The results of this testing emphasize the potential public health problem which hepatitis A infection poses for the Alaska Native people. Extrapolating the age-specific results of the survey, and including recent births, some 44,000 Alaska Natives may be susceptible to the disease. Given the high rates of infection during earlier epidemics, this disease remains a public health concern.

# THYROID HORMONE AUTORADIOGRAPHIC EXPERIMENTS ON SMOLTING COHO SALMON

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Salmonids undergo a physiological metamorphosis called smoltification prior to entering salt water and beginning the marine phase of their life cycle. During smoltification salmon develop the olfactory imprint that is retrieved during sexual maturation and guides the fish back to the home stream to spawn. Thyroid hormone participates in the smoltification process and is known to be required for proper neural development in neonatal mammals and metamorphosing frogs. It is hypothesized that thyroid hormone is involved in neurological development in smolting salmonids. Further, this neurological development may be required for olfactory imprinting to occur.

We are attempting to locate neural centers with high thyroid hormone affinity during smoltification using both in vivo and in vitro autoradiographic methods. Thus far, in vivo autoradiography of pre-smoltifing coho salmon has identified the retina and olfactory mucosa as major targets of intracardially administered 125 I labeled triiodothyronine.

In vitro autoradiography requires that incubation conditions be identified using tissue homogenates prior to experimentation on thin sections. We have data suggesting that glycerol is required in the incubation medium.

# NIFEDIPINE AND HYDRALAZINE FOR TREATMENT OF HIGH ALTITUDE PULMONARY EDEMA

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The role of pulmonary hypertension in high altitude pulmonary edema is unclear. We hypothesized that reducing pulmonary artery pressure (PAP) would improve gas exchange and clinical status. In a double blind, placebo controlled fashion, we studied oxygen breathing, nifedipine 10-20mg sublingual, and hydralazine 10-20mg intravenously. Oxygen breathing immediately reduced pulmonary artery pressure and improved clinical symptoms, but values returned to baseline within minutes after discontinuing oxygen. Nifedipine improved gas exchange and dropped PAP by 50% within 15 minutes, but values started to return to baseline at 30 minutes. Hydralazine reduced PAP 50% in 30 minutes and its effect persisted for 1-2 hours. Arterial oxygen saturation improved without a fall in $PCO_2$, indicating improved gas exchange. We conclude that pulmonary vasodilators are effective in reducing PAP and improving clinical status and gas exchange in persons with HAPE. This work supports the concept that pulmonary hypertension is casually related to HAPE.

# 3% $CO_2$ BREATHING IMPROVES AMS BY INCREASING OXYGENATION, NOT BY INCREASING CEREBRAL BLOOD FLOW

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3% $CO_2$, 7% $CO_2$, room air, and oxygen, were given to eight climbers with high altitude headache and ten controls at 4,400 meters. Room air breathing was used as baseline. Oxygen breathing, as expected, improved the headache and decreased cerebral blood flow as measured in the middle cerebral artery by transcranial doppler. 3% $CO_2$ produced hyperventilation, with an increase in arterial oxygen saturation and a decrease in MCA velocity, and an improvement in headache. 7% $CO_2$ breathing resulted in hyperventilation, with an increase in saturation but a large increase in cerebral blood flow, and worsening of the headache. We conclude that 3% $CO_2$ improves headache by hyperventilation, and by decreasing cerebral blood flow rather than increasing it. Measures to increase ventilation and thus oxygenation at altitude are useful in treating acute mountain sickness. Cerebral vasodilatation worsens altitude headache.

# EPIDEMIOLOGY OF SEASONAL AFFECTIVE DISORDER IN FAIRBANKS, ALASKA

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Seasonal Affective Disorder (S.A.D.) with recurrent fall-winter depressions, alternating with spring-summer euthymia or hyperthymia, has a unique responsiveness of the winter depressive symptoms to phototherapy, as demonstrated in Alaska and elsewhere. To determine the potential clinical population with S.A.D. who may benefit from this new therapeutic modality, a cross-sectional study of the high latitude community of Fairbanks, Alaska (64°, 49°N) was performed during January through March, 1988. Structured interviews of one hour duration by trained interviewers were carried out in the homes of 310 residents chosen by stratified, systematic random sampling on the basis of census tract in the Fairbanks North Star Borough. The sample consisted of 49% males and 51% females from age 21 through 79. Racial makeup was consistent with other descriptions of the Fairbanks population: white 80%, black 10%, Alaska Native 7%, other 3%. Preliminary data analysis of information derived from the seasonal pattern assessment portion of the interviews suggest that the symptoms of S.A.D. are widely experienced. "Marked" or "extreme" change in energy level between summer and winter was reported by 23% of the respondents. Winter weight gain was reported by 67%, with half of those gaining weight by 10 pounds or more. "Irritability" was reported to be increased by 14% between December and February. Diagnostic criteria will be examined in relationship to psychosocial and demographic variables.

# HEPATITIS B AND HEPATOCELLULAR CARCINOMA

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Since the early 1970s, Alaska Natives have been known to have a high rate of hepatitis B viral (HBV) infection as well as high rates of sequelae of this infection, hepatocellular carcinoma (HCC). With the availability of vaccine in 1981, a demonstration project was undertaken in one area of the state followed by a statewide comprehensive program to control HBV and HCC. The program involved immunization of persons susceptible to HBV infection and twice yearly testing of persons who are chronic carriers of HBsAg for a tumor marker, alpha-fetoprotein (AFP) to detect HCC at early stage.

After immunization, the incidence rate of infection fell from 215 to 14 per 100,000. After introduction of AFP screening, the 1 year-case-fatality rate fell from 100% to less than 50%. The presentation will review the data from the control program as well as describe additional studies underway to understand the pathogenesis of HBV infection and liver cancer.

# WOMEN WHO COMPETE IN LONG DISTANCE WINTER EVENTS: A DESCRIPTIVE PROFILE

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Women have been entering long distance winter sports in increasing numbers in Alaska and other states and countries. Much publicity has been given to the success of some. The 1,100 mile Iditarod Sled Dog Race across Alaska has been won by a woman every year since 1985. The Minnesota Beargrease Sled Dog Marathon 500 mile race was won by a woman in 1988. But what of the experience of the average female entrant?

This investigation sought to examine the circumstances of each of the women who competed in the Iditarod, Iditaski, Iditabike, Yukon Quest and Beargrease Marathon. Since December 1987, 79 questionnaires were mailed to all of the women participants (past and present) of these events and as of July 1988 the response rate was 58%. Examination of the findings in the areas of age ranges; training/competition miles; types, rates, self-treatment of injuries and protection from cold are reported.

# ENZYME IMMUNOASSAY FOR THE DETECTION OF PNEUMOCOCCAL C POLYSACCHARIDE IN SPUTUM OF PATIENTS WITH PRESUMPTIVE PNEUMOCOCCAL PNEUMONIA.

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Enzyme immunoassay (EIA) has been proposed as a sensitive and specific method for the rapid detection of antigens in body fluids of patients with invasive diseases caused by Streptococcus pneumoniae. We evaluated a prototype modified sandwich (EIA) designed for the detection of pneumococcal C polysaccharide (PnC) in sputum. PnC is a species specific cell wall component of all pneumococcal serotypes. Sputum samples were collected from 62 patients presenting at the Alaska Native Medical Center with a suspected diagnosis of pneumonia. Sputum were assayed for PnC by the EIA and results were compared to those obtained by sputum culture. Of 44 patients diagnosed with X-ray confirmed pneumonia, 12 were both sputum culture positive for S. pneumoniae and for PnC by EIA ($OD_{405}$>0.25; sensitivity 100%). Of those pneumonia patients with sputum samples that were negative for S. pneumoniae, 25 of 32 were EIA negative (specificity 78.1%). Seven pneumonia patients were culture negative but were EIA positive. Of these, four had documentation of having received antibiotics one or more days prior to sputum collection. Including these four patients, a predictive value of 84.2% could be calculated. Results suggest that the PnC EIA may be a sensitive and specific assay for the detection of pneumococcal pneumonia.

# ENZYME-LINKED IMMUNOSORBENT ASSAY FOR QUANTITATIVE DETERMINATION OF IgG AND IgM ANTIBODIES TO PNEUMOCOCCAL CAPSULAR POLYSACCHARIDES

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Streptococcus pneumoniae is a common cause of pneumonia, otitis media, bacteremia, and meningitis with certain individuals having an increased risk of fatal outcome to pneumococcal disease. These high risk individuals, particularly among the Alaska Native population, include young children, elderly persons, and persons suffering from alcoholism. A means of protecting these individuals from invasive pneumococcal disease is the use of the 23-valent pneumococcal vaccine. While the total serotype specific immune response to vaccination can be measured by radioimmunoassay (RIA), little is known about the acquisition of protective serotype-specific isotype-specific antibody following vaccination or infection.

Our laboratory has developed an enzyme-linked immunosorbent assay (ELISA) to quantitate serotype-specific IgG and IgM antibodies present in prevaccination and postvaccination serum from individuals immunized with the 23-valent pneumococcal vaccine. The assay used purified type-specific pneumococcal capsular polysaccharides as antigen to absorb to the solid-phase microplate wells and commercially available enzyme-conjugated isotype-specific antibodies. Antibody levels are expressed as nanograms per milliliter of serum calculated from a standard curve constructed by testing affinity-purified IgG and IgM labeled with $I^{125}$. To eliminate the possibility of detection of anti-pneumococcal C polysaccharide antibodies (anti-CPS) sera, samples were incubated with an excess amount of soluble CPS in order to neutralize any anti-CPS present before testing with the ELISA. Results of this enzyme-linked immunosorbent assay are compared with the total antibody values measured by RIA and are in agreement, with both postvaccination IgG and IgM antibody levels showing a good correlation with total RIA antibody for most serotypes tested.

# IDITAROD ARCTIC SPORTS MEDICINE RESEARCH PROGRAM

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The Iditarod Race requires a sled to be pulled by dogs over a thousand miles of harsh Alaskan territory, under extreme weather conditions for a minimum of about eleven consecutive days. This setting is a natural cold weather laboratory which enables the researcher to investigate men and women during human arctic performance. Both humans and canines must possess excellent physical work capacity. The challenge of fitness, injury care and prevention and peak performance in cold activity is an area of concern for Arctic Sports Medicine. A team of many health related professionals (e.g., researchers, clinicians and educators) from several Alaskan communities within the discipline of Arctic Sports Medicine has been working extensively on a unique research program over the course of the Iditarod Trail (Anchorage, McGrath, Unalakleet and Nome). Investigations were undertaken to examine physiological phenomena that reflect the exertion of men and women in the cold: 1) dehydration (blood analysis), 2) protein loss (urine analysis), 3) fat utilization (bio-electrical impedance analysis), and 4) fitness levels (anthropometry, strength, muscular endurance, flexibility and cardio-vascular tests). The purpose of this paper is to present an overview of past research findings produced by the Iditarod Arctic Sports Medicine Research Program as well as to discuss possible future research questions to better understand humans in arctic performance.

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Technical Session E
BIOLOGICAL SCIENCES

## *Section 2*

## *Modern Ecology*

Section Chair: John Bryant
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# COMPETITION BETWEEN AQUATIC MICROORGANISMS FOR OSCILLATING SUPPLIES OF PHOSPHORUS

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Phosphorus is often considered to be the key nutrient which limits phytoplankton production in freshwater aquatic systems. Most competition studies have measured the responses of individual phytoplankton under steady-state conditions in order to predict which species will dominate. Often, however, nutrient inputs to aquatic systems are not constant and phytoplankton must compete with other aquatic microorganisms for limiting nutrients. We have examined the responses of a green alga (Selanastrum capricornutum) and a heterotrophic yeast (Rhodotorula rubra) in gnotobiotic continuous cultures when phosphorus-limited steady-state populations are subjected to pulses of phosphorus. We have found two factors are important in controlling the outcome of phytoplankton competition in freshwater systems; the interaction of phytoplankton with heterotrophic microorganisms may ultimately be controlled by available carbon and organisms respond differently to oscillating rather than continuous supplies of nutrients.

# ECOSYSTEM CONSEQUENCES OF MULTIPLE LIMITING FACTORS IN NATURAL ECOSYSTEMS

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Nutrient availability, light, and air temperature were altered singly and in combination in a tussock tundra ecosystem in northern Alaska. After three years of these manipulations, growth of individual species responded individualistically to each manipulation, but total productivity was not significantly affected except by the combination of increased light and temperature. Mosses were the only growth form in which all species showed consistent response to manipulations. Rates of nutrient flux through each species were also altered by each manipulation, but nutrient cycling through the entire community was affected only by nutrient addition. We conclude that the multiple factors which limit growth of individual species in this tundra community buffer ecosystem processes of productivity and nutrient cycling in a manner not predicted by the response of individual species.

# SOURCES OF NITROGEN AND CARBON IN A SOUTHEASTERN ALASKAN STREAM: STABLE ISOTOPE EVIDENCE FOR THE IMPORTANCE OF RETURNING SALMON

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The return migration of anadromous Pacific salmon to spawn and die in freshwater represents a reverse flow of nutrients when compared with the concept of river transport of terrigenous materials to the oceans. Results of research using the natural variation of nitrogen stable isotope abundances as a tracer of marine biogenic nitrogen into Sashin Creek, southeastern Alaska, strongly support the hypothesis that coastal stream food webs are dependent on salmon as a nitrogen source. Stable carbon isotope ratios of rainbow trout (Salmo gairdneri) from different sections of Sashin Creek have distinctive isotopic signatures implying at least three carbon sources: carbon-13 depleted terrestrial detritus, atmospheric carbon dioxide and marine organic carbon. The stable isotope ratios suggest that both nutrients passed through the stream foodweb as well as salmon eggs and fry support resident fishes in the salmon spawning section of Sashin Creek.

# ORGANIC NITROGEN UPTAKE BY ARCTIC TUNDRA PLANTS

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Pool sizes and rates of formation of inorganic nitrogen (N) are generally accepted as the parameters that best describe the availability and supply of soil N to plants. Hence, studies on the ecology of plant N nutrition and N cycling in terrestrial ecosystems have focused on the dynamics of inorganic forms of N in relation to plant uptake. The present study of arctic ecosystems found that tundra soils have higher soil solution concentrations of free amino acids than of ammonium, the predominant form of inorganic N. Uptake experiments using glycine, aspartic acid and glutamic acid showed that, at naturally occurring soil concentrations, these amino acids may account for over 50% of the total N potentially absorbed by the major plant species. This uptake of amino acids circumvents the process of N mineralization which is considered a key control point in terrestrial N cycles. Previous studies of N cycling based exclusively on the dynamics of inorganic forms of N will have to be reconsidered in the light of this new perspective on plant-nitrogen relationships in the arctic.

# DECOMPOSITION OF AMINO ACIDS IN MARINE SEDIMENT POREWATERS

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Radiolabeled amino acids are useful for studying the bacterial decomposition of amino acids in marine sediments. However, some past work indicates that the added tracers may decompose faster than the amino acids which are present naturally in the sediment, leading to erroneously high measured decomposition rates. These results suggest that some of the amino acids dissolved in sediment porewaters are "complexed" and thus unavailable for microbial uptake. The purpose of the experiments described was to determine whether added, radiolabeled amino acids decompose at the same rate as porewater-dissolved amino acids.

Porewaters were extracted from bottom sediments obtained in Resurrection Bay and Skan Bay, Alaska. $^{14}C$-labeled glutamic acid, alanine, serine, glycine, and lysine were added to separate porewater subsamples, and their decomposition over time was observed and compared to the decomposition of the amino acids naturally present in the porewater. In over 90% of the experiments in which significant decomposition occurred, there was a 1:1 correspondence between the proportions of radiolabeled and natural amino acids taken up or respired by bacteria. There was no evidence that any amino acid "complex" was present which affected radiolabeled and natural amino acids differently.

# VEGETATIVE REPRODUCTION OF ARCTOPHILA FULVA

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Arctic pendant grass (Arctophila fulva) occurs throughout much of Alaska, but it is most prominent as an emergent in the shallow margins of ponds in the Arctic. Its occurrence has been associated with prime waterfowl habitat in the Arctic. Because waterfowl and other birds frequent ponds containing this grass, propagating the species into new areas has become a point of interest, particularly in the Prudhoe Bay vicinity.

A study of the autecology and habitats for Arctophila fulva began in 1985. The purpose was to determine the feasibility of vegetating impoundments and other water bodies with this grass to improve the usefulness of those environments to migratory waterfowl and other birds nesting on the coastal plan of northern Alaska.

Vegetative reproduction has proven to be the easiest method for propagating this species. Detached stems readily root at nodes and produce adventitious shoots, which can develop into independent plants and form colonies. Arctophila fulva stems naturally remain green and alive during winter, if frozen in the ice. These over-wintering plants resume growth as soon as ice thaws in spring. Stems can be harvested and stored fresh in cold rooms or refrigerated over winter and planted the following spring. Rhizomes can be frozen and remain alive for extended periods. Phosphorus fertilization substantially enhances vegetative reproduction of natural and planted Arctophila fulva stands.

Sexual reproduction is common for plants in the foothills of the Brooks Range and southward. Sexual reproduction is uncommon in plants on the coastal plain at Prudhoe Bay.

# SOME IMPLICATIONS OF LAKE BASINS FOR THE LANDSCAPE ECOLOGY OF THE ALASKAN ARCTIC COASTAL PLAIN

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The tundra of the Alaskan arctic coastal plain has essentially all been reworked by thaw lake processes leaving a mosaic of lakes and drained lake basins of various ages. Vegetation and soils within drained lake basins are correlated with time since drainage and with the degree of drainage (i.e. soil moisture). Detrended correspondence analysis of vegetation data from 14 drained lake basins in the vicinity of Barrow, Alaska was used to ordinate drained lake basins. The first axis of this ordination is easily interpretable as a successional feature. The second axis of the ordination is interpretable as being related to soil moisture and associated environmental conditions. Aspects of soil nutrition are correlated with both successional age and with soil moisture. Available phosphorus decreases with site age, while water extractable ammonium increases with soil moisture. Soil carbon appears to accumulate in these thaw lake basins through time. Lacustrine sediments in drained lake basins are often covered by surface peat accumulation of up to more than a decimeter. Mass of organic accumulation in basins appears to be both a function of basin age and hydrologic regime. Because both successional and hydrological phenomena are integrated at the scale of thaw lake basins, land use managers, wildlife ecologists, and landscape ecologists should find basins a useful natural unit for the understanding of coastal arctic ecosystems.

# CARBON ISOTOPE RATIO GRADIENTS IN WESTERN ARCTIC ZOOPLANKTON AND IMPLICATIONS FOR BOWHEAD WHALE FEEDING

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Zooplankton from 87 stations in the Bering, Chukchi, and Beaufort Seas sampled in 1985, 1986, and 1987 showed geographic gradients in both stable carbon isotope ratios and taxonomic composition. The zooplankton most depleted in $^{13}C$ were found in the central and eastern Beaufort Sea and those most enriched were from the Bering and Chukchi Seas. Copepod del $^{13}C$ values ranged from -20.9 to -26.0 ‰ and euphausiids ranged from -19.4 to -25.1 ‰. Across the Beaufort Sea alone, copepods and euphausiids decreased in $^{13}C$ by 3.0 and 2.7 ‰, respectively, from west to east in October 1986. Euphausiids showed a minimum of one part per thousand.

Relative biomasses of major zooplankton taxa varied significantly across the Alaskan Beaufort Sea in October 1986, with euphausiids dominating in the west and copepods in the east. These differences in taxonomic composition affected the weighted $^{13}C$ values for "total" zooplankton and produced an even more pronounced geographic gradient than found for copepods or euphausiids alone. The isotopic gradient is the probable source of isotopic oscillations along the baleen plates of the planktivorous bowhead whale (Balaena mysticetus) that migrates between the northern Bering and eastern Beaufort Seas.

# TROPHIC STRUCTURE OF THE BENTHIC INVERTEBRATES OF AN ARCTIC TUNDRA BEADED STREAM AND THEIR ASSOCIATION WITH MICROBIAL INDICATORS OF FOOD QUALITY

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Benthic macroinvertebrate samples were taken over the ice free season (June through September) of 1986 and 1987 from seven microhabitats of Imnavait Creek, a headwater tributary of the Kuparuk River on the north slope of the Brooks Range. Relative densities and biovolumes of the benthic fauna as well as six indices of microbial food quality of benthic sediments were determined for paired benthic samples. Gut content analysis of 38 taxa of macroinvertebrates present showed that over one third of the taxa present are predatory, and that Chironomidae were the most common prey. Chironomid species were primarily consuming algae. The algae to peat ratio of Chironomid gut contents changed over the season, with more algae consumed later in the season, corresponding to a greater availability of algae later in the season. Total invertebrate densities and biovolumes were significantly correlated ($p < .05$) with both microbial respiration and with chlorophyll *a* content of the sediments. Invertebrate densities and microbial respiration of the sediments differed significantly ($p < .05$) among microhabitats, with deep habitats having lower values than shallow habitats.

Technical Session E
BIOLOGICAL SCIENCES

## *Section 3*

## *Ecology and Quaternary Studies*

Section Chair: Scott Armbruster
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# DEEP THERMOKARST LAKES IN THE SOUTHERN YUKON FLATS, ALASKA.

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The southern margin of the Yukon Flats tectonic basin, northeast interior Alaska, is formed by a gravel terrace overlain by up to 30 m of loess. Numerous deep (10-25 m) lakes appear to be of 3 types: a) lakes in broad swales, b) lakes in underfit drainages, and c) lakes indenting high ground. Sediments taken from lakes of type b) and c) date lake origin to ca 14,000-10,000 yr B.P. The lowermost sediments contain alternating bands of rapidly accumulated silt and coarse organic detritus suggestive of thermokarst origin.

A river cut has exposed lacustrine deposits buried by silt and underlain by woody detritus. They contain a pollen record of boreal forest vegetation and are probably of interglacial age.

Lakes in the southern Yukon Flats may form when large ice masses melt within the silt, e.g. ice-rich sediments along drainages or syngenetic ice wedges, formed during periods of loess deposition. They are long-lived, compared with other kinds of thaw lakes. Cycles of lake development may be initiated during periods of climatic warming.

# HOW TO RECOGNIZE AND INTERPRET THAW-LAKE SEDIMENTS

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Palynologists avoid obvious thaw lakes because of anticipated problems of contamination by redeposited pollen, but several Alaska's most interesting long pollen records evidently came from unrecognized thaw lakes. Because they are respositories of well-preserved macro-plant remains, thaw-lake deposits, in fact, can amplify and clarify the pollen record, but the potential for redeposition must be taken into account. For these reasons and other reasons, it is important to be able to recognize ancient thaw-lake deposits.

The thaw-lake sediment sequence, seen in cross section, consists of (1) a basal, time-transgressive sequence consisting of cross-bedded, coarse-grained sediments and coarse, organic detritus and (2) an overlying thin-bedded silt and detrital peat unit which was deposited in the quiet water of the central basin. Thick accumulations of detrital peat, representing lee-shore accumulations of organic detritus, may also appear at the margins of some bodies of thaw-lake sediment sequences. The presence of ice-wedge pseudomorphs and remains of molluscs or aquatic micro-fossils uniquely distinguishes thaw-lake sediment sequences.

# The Effect of Thaw-Lake Development on the Deposition of Plant Macrofossils

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Thaw lakes form as a result of the thawing and subsidence of ice-rich sediment. They are conspicuous features on the landscape in the arctic and subarctic regions of Alaska and western Canada. Home for many migratory waterfowl species and a diversity of invertebrate faunas, they are also a repository for terrestrial plant remains. Thaw lakes have been forming on the Seward Peninsula in Alaska for the last 100,000 years, thus spanning a time period of complex climatic and environmental change. They have the potential to provide detailed information about how vegetation responded to these changes. However, it is important to study the process by which plant material becomes incorporated into thaw-lake sediments and the extent to which the plant macrofossils represent the terrestrial vegetation surrounding the lake. A recent study of two active thaw lakes on the northern Seward Peninsula sheds light on the processes by which plant material enters a thaw-lake basin and is buried in the sediment.

I collected a series of macrofossil cores along the shores of Egg and Berry Lake and another series of cores ranging from 2-10 m offshore. The stratigraphy of the offshore cores differed markedly between the two lakes. Cores of Egg Lake contained lenses of terrestrial plant remains very close to the surface, whereas the cores from Berry Lake contained a zone of compacted terrestrial plant remains at the base. The differences between the two lakes reflects differences in their topographic setting and distribution of ground ice in the host sediments. Egg Lake formed in a plateau which contains syngenetic ice wedges that upon thawing produced a deep, steep-sided basin. In response to exposure and wave erosion the bluff sediment slumps, slides, and flows into the lake, carrying large chunks of turf into the lake. The lenses of matted organics found in the offshore cores of Egg Lake represent repeated episodes of turf that slid into the lake. When the turf enters the lake it may be buried as a single coherent mass by saturated silt and sand from the bluff, or it may fragment into smaller pieces and dissipate into a thin, continuous layer of organic-rich silt.

Berry Lake formed at the periphery of an older thaw-lake basin that drained about 1,500 years ago, and is the result of the thawing of a smaller amount of ground ice. The banks of Berry Lake are in general, less than 1.5 m high and vegetation is undercut and calves off the top of the bank more or less continuously. Wave action from strong winds churns up the lake sediment which then quickly buries vegetation that has subsided into the lake. Some of the collapsed chunks or turf migrate along the margin of the lake basin before they are buried in the lake sediment.

This study suggests that the both the origin and ontogeny of a thaw lake profoundly influence the deposition of plant macrofossils in the lake sediment. Ultimately, they may influence the degree to which the plant remains preserved in the sediment reflect their source vegetation.

# THE ORGANIZATION OF FLOWERING TIMES IN GUILDS OF INSECT-POLLINATED PLANTS ON SOUTH-FACING BLUFFS IN INTERIOR ALASKA

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In this study we evaluate the hypothesis that reproductive interference has organized flowering times of the insect-pollinated flora of south-facing bluffs in interior Alaska. There was some evidence that flowering times of the entire flora, the short-tube guild, and the open-flower guild were uniformly dispersed, a result consistent with the reproductive interference hypothesis. We found no evidence for clumped flowering times. We evaluated hypotheses about the causes of uniformly dispersed flowering times in these guilds. The phenology of the short-tube guild was consistent only with the hypothesis that flowering times evolved to reduce reproductive interference in a once continuous flora. The phenologies of the entire flora and open-flower guild were best explained by the local extinction of some populations that had suffered the effects of reproductive interference. We conclude that reproductive interference has been an important factor in the organization of the flowering times of south-facing bluffs in interior Alaska.

# PALÉOECOLOGY OF A LATE-QUATERNARY CAVE DEPOSIT ON THE PORCUPINE RIVER ALASKA

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Lower Rampart Cave-1 is a small cave in a limestone/dolomite belt along the Porcupine River, northeast Alaska. The cave may have obtained its configuration by fluvial processes when the Porcupine River was approximately 30 meters above its present base-level, perhaps during a catastrophic flood at the end of the last glacial interval. The cave began to fill with unconsolidated sediment around the end of the last glacial stage and has continued to fill through the Holocene. In the late Wisconsin one of more glacial lakes in northern Yukon Territory breached the upper Ramparts of the Porcupine River and drained, leaving a scabland in the lower Ramparts.

LRC-1 contains a heterogeneous deposit consisting of inorganic sediment and fossil bone. The late-Quaternary large mammal fauna consists of *Mammuthus, Equus, Bison, Ovis, Rangifer,* and possibly *Ursus;* the Holocene fauna consists of *Rangifer* and *Ursus.* The fossil large mammal bones were brought to the cave by carnivores: probably by *Vulpes* and *Canis* during the Pleistocene. Extensive carnivore gnawing on the bones suggests that the cave may have been utilized as a rendezvous site during the spring and early summer seasons. Deciduous bear canines indicate that the cave was a bear den throughout the Holocene and perhaps in the late Pleistocene. A pedogenic calcite in the lower part of the section, and below the drip-line, may represent a stratigraphic marker of the early-Holocene thermal maximum, approximately 9-11,000 years ago. The first dated archaeological material appears about 3,500 years ago and consists of a hearth and several lithic flakes. Lower Rampart Cave-1 contains a stratigraphic record spanning the last 25,000 years and offers an unique opportunity to better understand the environment of the late Wisconsin glacial/interglacial transition.

# FACTORS CONTROLLING PLANT SPECIES DISTRIBUTIONS ON EAGLE BLUFF, ALASKA

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Interior Alaska's blanket of taiga is periodically interrupted by azonal steppe vegetation on steep, south-facing bluffs. Steppe vegetation forms a physiognomic and floristic unit dominated by Artemesia frigida and xerophilous herbs. Eagle Bluff (Eagle, Alaska) is covered with patches of steppe and forest. Steppe and forest understory species exhibit a range in community fidelity. We used correlative methods to generate hypotheses about controls over species distribution on the Bluff. Field experiments constituted a test of the model's predictions.

Environmental parameters and percent cover of species were measured on 70 plots along a 350m transect that traversed the gradient between communities. Species composition was ordinated using Detrended Correspondence Analysis (DCA). We developed a model positing causal linkages between environmental factors and DCA plot scores. Causality was inferred based on the relative strengths of regression coefficients using path analysis. The model explained 71.2% of the variation in DCA score ($p < .001$). The interaction of slope and aspect had the greatest direct effect on DCA score, followed with decreasing influence by soil temperature, photosynthetically active radiation (PAR), disturbance and soil moisture. The greatest response of understory vegetation in forested plots was to soil temperature. PAR had the strongest influence in steppe plots. Soil moisture had little effect in either habitat.

Experimental results suggest that the degreee of response to light and moisture is species specific. The nature and direction of the response is closely related to the species' native habitat.

Technical Session E
BIOLOGICAL SCIENCES

## *Section 4*

## *Physiological Ecology, Behavior and Systematics*

Section Chair: Robert White
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# ARRIVAL OF SPRING BIRD MIGRANTS TO ALASKA'S UPPER KOBUK AS A FUNCTION OF DAYLENGTH, TEMPERATURE AND WEATHER PATTERN

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Data has been gathered since 1984 on first sightings of spring bird arrivals to Alaska's Upper Kobuk River Valley. Historic arrival dates have been researched from longtime residents of the area. Using recorded weather observations, the arrival data will be used to determine if there is a critical daylength and/or weather factor that correlates with first spring sightings.

# WHAT'S IN A SUBSPECIES?;
# A MOLECULAR COMPARISON OF ALASKAN SONG SPARROW POPULATIONS

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Song Sparrows are extremely polytypic across North America, with seven subspecies presently recognized in Alaska based on size, beak morphology, and plumage differences. Mitochondrial DNA (mtDNA) comparisons have been made between four subspecies, Melospiza melodia amaka, M.m. maxima, M.m. sanaka, and M.m. kenaiensis in order to test for the genetic uniqueness of populations. Preliminary results are presented showing the phylogeographic structure of mtDNA variation. Evidence for gene flow between populations is discussed with consideration of life history and demography of Song Sparrows, maternal transmission of mtDNA, and implications for the subspecific classification of this species.

# SUBSPECIFIC AFFINITY OF WOLVES FROM THE FINLAYSON AREA, YUKON TERRITORY, CANADA

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Skulls from 27 adult wolves (12 females and 15 males) killed as part of a 1983 predator control project in the Finlayson area, Yukon Territory, Canada, were studied to determine their craniologic characteristics. Sexual dimorphism and subspecific affinity of the male sample were assessed utilizing statistical tools ranging from univariate to multivariate analysis.

Finlayson wolves were found to exibit a similar range in sexual dimorphism as other North American wolf populations, with males ca. 5% larger in studied cranial dimensions than females. Finlayson and interior Alaska wolves (C.l. pambasileus) were found to be quite similar in 12 diagnostic measurements utilizing univariate statistics. Multivariate comparisons of Finlayson wolves with Alaskan wolf subspecies, utilizing 12 diagnostic measurements, further revealed a close affinity between the study sample and "Interior" wolves.

Based on univariate and multivariate cranial statistics Finlayson wolves are best classified as an "ecological race" of C.l. pambasileus, interior Alaska wolves, and likely part of a gradual intergradation between C.l. pambasileus and the nearby subspecies C.l. occidentalis.

188

# TIMING AND SYNCHRONY OF LAMBING AND RELATED MATERNAL BEHAVIOR IN DALL'S SHEEP

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Timing and synchrony of lambing in Dall's sheep was studied on Igloo Mountain in Denali National Park and Preserve during May - July 1988. Parturition was highly synchronized with 80% of births occurring over a two-week period in mid-May. Chronology of birthing behaviors is described from observations of lambing events. Rates and duration of suckling bouts are reported for May-July. Timing of parturition in this population is compared with predictions forwarded by Bunnell (1980, 1982) and Rutburg (1987) to explain timing and synchrony of birth in ungulates in relation to latitude and altitude.

# ASPECTS OF THE CACHING BEHAVIOR OF ARCTIC FOXES NEAR KOKECHIK BAY, ALASKA

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Arctic foxes (Alopex lagopus) near Kokechik Bay in the Yukon-Kuskokwim Delta of southwest Alaska switched from a diet based on microtines and carrion in the late winter to a concentration on eggs once the many birds using this rich nesting area initiated and incubated nests. Eggs were an abundant, highly accessible prey for the foxes for which there appeared to be no satiation point. For other prey, foxes appeared to expend energy only when they were hungry. Eggs however, were taken whenever they were encountered regardless of the foxes' hunger status.

Most eggs encountered by foxes were cached singly in scatter hoards. Eggs represented a highly concentrated protein source in an easily transported storage container that retained food value at least one year after burial. The caches represented a stockpiling of an abundant, yet time limited resource for future use. In the first half of incubation, almost all eggs were cached, but as the number of vulnerable nests available to foxes declined, there was a slight decrease in the proportion of eggs that were cached and an increase in the number of egg caches that were recovered. The shift in behavior appeared related to the amount of eggs encountered or rate of food renewal, rather than the absolute number available or the time period during the summer.

# IN VIVO GLUCOSE AND FATTY ACID OXIDATION IN REINDEER

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Substrate use for heat production in reindeer fed a low protein mixed lichen (ML) or a high protein pelleted ration (PR) was determined using a primed infusion of [U-$^{14}$C] glucose, a continuous infusion of [1-$^{14}$C] stearic acid and estimates of protein catabolized from nitrogen excretion. High protein intake for the PR was associated with high plasma glucose concentration and glucose irreversible loss (IL); however, the contribution of glucose to energy expenditure (EE) was low at 5 to 6% independent of diet. Reindeer fed the ML diet recycled more glucose carbon and restricted the physiological distribution of the glucose pool as judged by its space of dilution (18% ML vs. 25% PR). Stearate IL was twice as high for the high protein diet, but less was oxidized (40% PR vs. 65% ML) such that stearate also contributed only 5 to 6% of the resting EE of the reindeer. Extrapolation of stearate oxidation to total non-esterified fatty acids (NEFA) suggested that NEFA's could contribute 21 to 23% of EE. Protein contributed 2% of EE on the ML diet and 11% on the PR diet. Thus the oxidation of glucose + NEFA + protein accounted for 30% of the EE of reindeer fed the ML diet and 38% for those fed the PR diet. These results suggest that the reindeer is heavily dependent on oxidation of ruminal volatile fatty acids to satisfy its energy requirements for maintenance in winter.

†Deceased.

Technical Session E
BIOLOGICAL SCIENCES

## *Section 5*

## *Applied Resource Management*

Section Chair: Paul Allaback
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# KENAI LAKES INVESTIGATION PROJECT (KLIP): ACID RAIN RESEARCH IN ALASKA

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The purpose of the KLIP study is to provide quantitative information on the chemical status of lakes on the Kenai Peninsula. A probability sample of 60 lakes was drawn from a map population of 902 lakes (map scale of 1:250,000). Lakes were sampled by air and ground access during the period 15-23 August, 1988. Conductivity, color, and pH were measured in the field laboratory (USFWS Kenai Wildlife Refuge headquarters), and samples for cation, anions, and other parameters were refrigerated and shipped via an overnight carrier for AA and IC analysis, respectively, at EPA's Region X laboratory. Aliquots have been preserved for analysis of trace contaminants should funds become available.

The data obtained in this study will be comparable to data collected under EPA's National Surface Water Survey (NSWS) for the Lower 48. Data will be used to (1) characterize the lakes of the Kenai Peninsula with particular attention to parameters known to be influenced by acid deposition (ANC, Ca + Mg, $SO_4$, pH, etc.) and (2) compare the status of lakes on the Kenai Peninsula (which are primarily seepage lakes) with NSWS seepage lakes in the Upper Midwest.

Cooperating organizations for this study include U.S. Fish and Wildlife Service (Kenai National Wildlife Refuge), U.S.E.P.A. (Environmental Research Laboratory - Corvallis and Region X), Alaska Department of Natural Resources (Division of Geological and Geophysical Surveys) and ARCO.

# POLAR BEAR ALERT II - THE ANNUAL CAPE CHURCHILL POLAR BEAR MIGRATION AS A PROMOTED TOURIST ATTRACTION

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Recent years have seen a dramatic upswing in the numbers and the inevitable impact of tourist visits to the Churchill, Manitoba, area during the season of Polar bear migratory activity. This acceleration is in large measure a result of widespread publicity in the press and on television. In 1982 the National Geographic Society produced and disseminated its first television special, "Polar Bear Alert", which was viewed by millions in North America and overseas. It has been reshown on countless occasions and is readily available, widely sold, videocassette both over the counter and through catalog sales.

In keeping with the visual reputation of the National Geographic Society it is an excellent, highly photogenic, documentary which has whetted the traveling public's appetite for a personal experience. Fortunately for the travel agent, but unfortunately for the bear, Churchill is readily and quite inexpensively accessible to the major population centers of the continent. For a few hundred dollars over the cost of transportation to Winnipeg, the Hudson Bay coast can be reached by air or rail and comfortable accommodations secured.

Polar bear viewing has become big business. Three local companies operate out of Churchill and package tours are available through travel agencies in the lower 48 and southern Canada. Short term capacity has nearly been reached; expansion of facilities is a tempting opportunity.

Wildlife management authorities have had to take additional measures to protect the migrants from the tourist onslaught. The famous town dump is no longer accessible to scavenging bears and photo hungry tourists, the trapping and temporary confinement leading to relocation of more venturesome animals has had to be intensified, and close supervision of guide services mandated. Nonetheless abuses do occur and far more stringent regulation tourist activity may well be instituted.

If today's film industry practice of producing sequels designated by Roman numerals applies in this instance, Polar Bear Alert II could lead only to increased visits to the local zoo. The Churchill polar bear range will be off limits to the public.

# SELECTION OF RESEARCH NATURAL AREAS FOR THE TONGASS NATIONAL FOREST

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The Tongass National Forest Land Management Plan (TLMP) is the first in the nation to come due for a comprehensive revision and adoption under the standards of the National Forest Management Act. The plan in effect now (TLMP1) did not address the need for new Research Natural Areas (RNA's). A proposal for 30 new RNA's in TLMP2 has been developed and presented to the planning team. The proposal is subject to revision as it moves through higher administrative levels of the Forest Service and public review and comment in the process of developing a draft TLMP2.

The 30 RNA candidate sites have been chosen to represent uncommon or range-limited plant species, geologic/landform features, wildlife species of special interest, and plant community types.

Candidate areas with geologic features of special interest include Blue Lake Lava Flow on the mainland in northern Misty Fiords National Monument, a 100-150 year-old flow with a variety of typical formations. Crater Ridge-Fred's Creek includes subsidiary Quaternary volcanic cones and a unique ash soil watershed near Mount Edgecumbe. Akwe Beach south of Yakutat includes coastal dune formations, including dune ridge and swale. Hot springs at Upper Tenakee Inlet and Bailey Bay are recommended for inclusion.

Pike Lakes contains the only coastal population of northern pike. Twin Lakes supports moose on the floodplain of the Stikine River. The Salmon Bay Waterfowl area has an overwintering population of trumpeter swan. Areas such as Gambier Bay and Plotnikof-Point Banks contain high densities of bald eagle, brown bear, and anadromous fisheries and sitka black-tailed deer winter habitat.

Nearly half of the targeted rare plant species occur in the northern Lynn Canal area. Warm Pass and Dayebas Creek have been selected to include these plants. Thunder Mountain and Mount Clader-Virginia Mountain are suspected glacial refugia, the latter supporting the only outer coastal stand of subalpine fir in southeast Alaska. Chaik Bay on southwestern Admiralty Island contains a superlative stand of high-volume, high-productivity old-growth riparian sitka spruce forest.

The results of scientific research and new inventory efforts by a variety of agencies and investigators has considerably improved our understanding of the natural diversity of the Tongass National Forest in the last decade. Scientists and naturalists will play an important role in deciding the fate of RNA proposals in TLMP2.

# UNCOMMON PLANTS AS A SELECTION CRITERION FOR RESEARCH NATURAL AREAS IN THE TONGASS NATIONAL FOREST

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Vascular plant species that are rare, uncommon, or of biogeographic interest were identified to assist in the selection of new Research Natural Areas (RNA's) on the Tongass National Forest. One hundred forty eight species were reviewed. Species were chosen because they (1) exhibited an unusual distribution pattern in southeast Alaska as depicted in Hulten's Flora of Alaska, most often being restricted to extreme southern or northern southeast, or (2) were known from three or fewer collections.

Fifty eight species were included on the final list. Species of special biogeographic interest that are uncommon in southeast but common over much of their range include Geocaulon lividum (Richards) Fern., Dryas integrifolia M. Vahl, Diapensia lapponica L., and Symphoricarpus albus (L.) Blake; all are restricted to northernmost southeast. Globally common species that just reach southernmost southeast include Melica subulata (Griseb.) Scribn., Physocarpus capitatus (Pursh) Ktze., Spiraea douglasii Hook, Crataegus douglasii Lindl., Viola sempervirens Greene, and Monotropa uniflora L.

Globally less common species that occur in southeast include Poa laxiflora Buckl., Cypripedium montanum Dougl., Viola selkirkii Pursh, Rhododendron camtschaticum Pall., Galium kamtschaticum Steller, and Cirsium edule Nutt. Recent collections of Thlaspi arcticum Pors., a candidate for the federal threatened and endangered species list, suggest that it may occur in the northernmost portion of southeast.

## *Workshop 1*
## *ALASKA SCIENCE AND TECHNOLOGY FOUNDATION*

Chair: Henry Cole
State of Alaska
Juneau, Alaska

# ESTABLISHING THE ALASKA SCIENCE AND TECHNOLOGY FOUNDATION: WHAT IS ITS PURPOSE?

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The Alaska Science and Technology Foundation (ASTF) was authorized by the legislature in 1988. This paper discusses the limits of the legislation and problems of implementing it that confront the ASTF's board of directors and the governor's office. In addition to analyzing the law, the paper reviews current literature on science and technology programs in other states and draws parallels between the Foundation and the Alaska Council on Science and Technology, which was terminated by the Legislature in 1984.

The paper focuses on the problem of defining the ASTF's purpose and on related terms and concepts such as "technological innovation," "basic and applied research," and "problem-solving and development." It also discusses how definitions of purpose affect program resources, implementation strategies, policy structure, and administrative processes. Special attention is given to identifying several constituencies of the ASTF, including policymakers, the public, and diverse groups of scientists, engineers, and technology entrepreneurs.

The paper concludes that, as now outlined in its authorizing statute, the Foundation lacks a coherent sense of purpose and direction and has limited prospects for sustained political or financial support. It recommends that the governor's office and the ASTF's first board of directors immediately begin planning for a long term, organized research and development program targeted on a strategically selected Alaska problem area.

## *Workshop 2*
## *COMMITTEE ON ARCTIC SOCIAL SCIENCES, POLAR RESEARCH BOARD*

During this workshop, the Committee on Arctic Social Sciences of the Polar Research Board, National Academy of Sciences, will present preliminary findings of its study of arctic social research needs. Composed of U.S. and Canadian scientists from universities, governmental and private organizations, and representing ten social and behavioral science fields, the committee was established in 1987 to develop priorities for social science research in the Circumpolar North.

The committee has prepared a paper that will be used as a basis for workshop discussions. This paper presents multidisciplinary research initiatives in the social sciences for the Arctic, and outlines organizational or infrastructure changes required to support these initiatives. Research themes addressed include human/environment relationships, community viability, and rapid social change. Early copies of the discussion paper have been transmitted to expected workshop participants; additional copies will be available at the workshop.

After initial presentations by the committee, workshop participants and committee members will break into several smaller working groups to discuss in depth material outlined in the discussion paper. All workshop participants are encouraged to participate in the working group(s) of their choice.

Members of the Committee on Arctic Social Sciences include: Douglas Anderson, Brown University, Providence, RI; Ernest Burch, Burch Associates, Harrisburg, PA; Constance Hunt, Canadian Institute of Resources Law, Calgary, Canada; Robert Kraus, University of Kentucky Medical Center, Lexington, KY; John Kruse, Institute of Social and Economic Research, Anchorage, AK; Edna Maclean, State of Alaska Department of Education, Juneau, AK; Claus-M. Naske, University of Alaska Southeast, Juneau, AK; Arlon R. Tussing, Arlon Tussing and Associates, Seattle, WA; and Peter J. Usher, P.J. Usher Consulting Services, Ottawa, Canada.

Funding for the work of the Committee on Arctic Social Sciences has been provided by the State of Alaska, the National Science Foundation, the Bureau of Land Management of the Department of Interior, and the Smithsonian Institution.

Co-Chair: Mim Dixon
Chief Andrew Isaac Health Center
Fairbanks, Alaska

Co-Chair: Oran Young
Center for Northern Studies
Wolcott, Vermont
and Dartmouth College
Dartmouth, New Hampshire

## *POSTERS*

Chair: Mary Ann Borchert
Graduate Studies
University of Alaska Fairbanks



198

# HEALTH EFFECTS OF THE ECONOMIC RECESSION: OIL PRICES AND HEALTH IN THE FAIRBANKS NORTH STAR BOROUGH

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A community survey of 310 randomly selected Fairbanks Borough residents were interviewed individually in one-hour interviewing sessions and were asked questions regarding their personal finances, work situations, personal health and habits, and their use of alcohol and other drugs. The sample was drawn from 14 randomly selected census blocks that are representative of the Borough's demographic profile. Eligibility of respondents was defined as persons 21 years of age and older and who had resided in the Borough at least six months. Those interviewed were 50% women, 6% Native, 9% Black, and of the total sample 44% has lived in Alaska 13 years or longer. Interviewing took place from mid-January through mid-March, 1988. The main purpose for this study was to assess the effects of economic strain, namely unemployment, underemployment and loss of income, associated with the Alaska oil recession on the health status of people living in the Borough. Particular attention was paid to demographic characteristics such as sex, marital status, and ethnicity in connection with employment and economic status.

This presentation will highlight findings that demonstrate a link between economic conditions and health practices. For example, alcohol, drug and tobacco use were reported more frequently by the unemployed than by the full-time employed. Alcohol use was found to be 11% higher among the unemployed than those employed full-time. Generally, the findings support the expectation that economic hard times adversely affect the health of members of the community involved. Funding for this project was provided by the Alcoholic Beverage Medical Research Foundation at Johns Hopkins University, with a supplemental grant from the University of Alaska Foundation.

# PERSONALITY PROFILES OF IDITAROD MUSHERS, 1987-1988 RACES

Natalie and Glen Dean, Dr. Allan Turner
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Sports Medicine Research Project
Center for High Latitude Studies
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The purpose of this study was to examine the differences and similarities among the Iditarod competitors. The athletes competing in the annual event were administered a personality profile test, the 16 PF. Results were examined and compared with finish places, age, and experience. When age is compared to measure for relaxed or tense (Q4), it may be determined that the younger participant was more tense ($r = -.66$, $p < .005$). Factor A (reserved vs. warmhearted) was generally low for all mushers and especially low for women — indicating they would rather work alone and have high personal standards. These mushers may represent personalities typical of an arctic athlete.

# SPRING BIRDING AS SET INDUCTION FOR WILDLIFE WEEK UNIT

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Students watch for spring bird arrivals and note the number of species seen each day as introduction to wildlife week unit. They endeavor to spot the first spring arrival of each migrant species. Where possible they use the Inupiaq as well as English name to identify each bird. In class the number of new arrivals can be discussed by species as well as wintering areas and migration paths. These activities then lead to a wildlife week and/or biology unit.

# TWO POLLEN RECORDS FROM ARCTIC ALASKA

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The two pollen diagrams represent a detailed record of climate and vegetation changes in arctic Alaska from the last interglacial to the present. The records presented are Ahaliorak Lake from north of the Brooks Range and Oil Lake, situated near Taolik Lake, along the Yukon River.

The pollen analysis of the top three meters of sediments of Ahaliorak was undertaken in 1987. The pollen was counted for percentages and concentrations and four zones were described. These are a birch-grass zone, a herb zone, a birch zone, and an alder zone. The top three zones correspond to Livingstone's three zone sequence for the Brooks Range. Grass-sedge ratios were important in our zonation scheme. High grass-sedge ratios at Ahaliorak Lake, as elsewhere in north Alaska, are associated with high [illegible] pressures, which are due to cold, perhaps the highest levels ever recorded. Notable also are the [illegible] at the late glacial/Holocene boundary. Although [illegible] the Holocene, [illegible] the late glacial. [illegible] the Holocene pollen and a [illegible] of the Ahaliorak Lake record.

[illegible] Beringian [illegible] Chronology [illegible] Beringia [illegible] Chronology [illegible] Beringia [illegible] Chronology [illegible] Beringia

# VARIATIONS IN COMPLEXITY IN RANGE FRONT STRUCTURES, ATIGUN GORGE, NORTH-CENTRAL BROOKS RANGE, ALASKA

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Tremendous variations in structural complexity occur in the thrust-faulted and folded rocks exposed across Atigun Gorge, at the northern mountain front of the Central Brooks Range, Alaska. South of Atigun Gorge, overturned folds, folded thrust faults, and completely upside down rock units of Devonian to Permian age indicate at least two distinct stages of deformation. The first stage of deformation involved the thrust stacking and transport of Devonian to Permian rock units, forming a duplex. The second stage of deformation involved folding of this duplex by thrust faulting and deformation of the structurally lower rocks. These deformational events are best seen in structurally competent, Mississippian limestone. Along Atigun Gorge, adjacent to the range front, younger, Mississippian to Permian clastic sediments, deformed by multiple deformations, are in the most complex structural position. Further to the north in the study area, Cretaceous Albian sedimentary rocks are only mildly deformed, indicating that most of the deformation of the area is pre-Albian.

Mapping and structural interpretation conducted in this study provide useful constraints as to the structural evolution of the Atigun Gorge area. Nonetheless, several tectonic models can explain the observed deformation. The model preferred by this study, involving significant thrust transport of the Devonian to Permian duplex and associated shales, and their subsequent deformation by thrust-faulting and folding of underlying rocks, is in agreement with its position at the Central Brooks Range mountain front. Additionally, the structural variations documented across the study area may be representative of range front structures elsewhere in the Central Brooks Range.

# A PORTABLE FABRIC HYPERBARIC CHAMBER FOR TREATMENT OF HIGH ALTITUDE ILLNESS

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We studied the use of a lightweight (4 kg) hyperbaric chamber at 4,400 meters on Denali for treatment of high altitude illness. Ten control subjects and nine pulmonary edema or mountain sickness subjects were given one hour of oxygen breathing (~30% $O_2$) and one hour of pressurization at 2 psi (100 torr) in the bag in randomized order. Alveolar oxygen pressures were matched for the two treatments to determine if pressurization had benefits in addition to raising the inspired oxygen pressure. Preliminary data analysis revealed similar increases in arterial oxygen saturation and similar changes in alveolar-arterial oxygen gradient with the two treatments. No change in hemoglobin was observed with pressurization, suggesting a rapid fluid shift into the intravascular compartment. The portable hyperbaric chamber appears to be a safe, effective, and practical method of treating mountain sickness and pulmonary edema. It avoids the weight and expense of oxygen cylinders, and can be used for longer periods of time. Increasing the $PO_2$ by pressurization or by raising inspired $PO_2$ are equally effective in treatment of high altitude illness. Further research to determine the optimal length of treatment with the hyperbaric chamber and to determine reoccurrence of high altitude illness after treatment are planned.

# Spatial and Seasonal Patterns of Streambed Water Temperatures in an Alaskan Subarctic Stream

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and Scott R. Ray
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Streambed temperature profiles were determined between 7 October 1986 and 19 April 1988 in an Alaskan subarctic stream. Hourly temperature recordings were made from two vertical profiles (near-bank and mid-channel) at 0, 5, and 10 cm depths in stream substrates. Air temperatures (daily mean) ranged from -41.6 °C to +22.5 °C, with a mean of -3.95 °C. The stream accumulated approximately 900 degree-days (above 0 °C) during the first year, with differences between profiles and depths (range 798 - 970 degree-days). In the first winter the near-bank streambed repeatedly froze and thawed during the winter, while the mid-channel streambed never froze. In spite of very cold air temperatures, the coldest temperature reached in frozen stream sediments (and potentially faced by stream invertebrates) was -2.5 °C. However, in the second winter both profiles froze to as much as -13.0 °C and remained frozen for most of the winter. Spatial and temporal patterns in water temperature were complex and indicated that streambed water was derived from both streamwater and groundwater. Amount of rain in late fall seemed to affect the hydrology and temperature dynamics of the streambed. In years with late autumn rains (greater groundwater storage), stream sediments may remain unfrozen through the winter, while in drier years sediments may freeze quite deeply. This year-to-year variation may have profound effects on stream invertebrates unable to tolerate freezing by affecting the size of unfrozen "refugia" available for overwintering.

# CONNECTIONS: FROM NOSE TO BRAIN TO BEHAVIOR

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The circuitry of the central nervous system underlies its function; and the classic discipline of neuroanatomy, much of which deals with the intrinsic connections of the brain, supports much of our knowledge of central nervous function. Recent advances in neuroanatomical technique, particularly for tracing connections, have moreover revolutionized the discipline and are being applied to all areas of neuroscience. One such technique employs the neuronal uptake and transport of horseradish peroxidase (HRP), which is readily detected histochemically. I used this method to approach the problem of the central nervous mediation of the diving response (DR). The DR comprises reflex apnea, bradycardia and peripheral vasoconstriction, conserving oxygen for the brain and heart while maintaining central blood pressure. It is exhibited by aquatic representatives of all the vertebrate classes, and appears related to certain other protective responses. Muskrats (*Ondatra zibethicus*) exhibit a strong DR triggered by wetting the nose. I injected muskrats with HRP in the nose under halothane anesthesia, and transcardially perfused with fixative 24-48 h later under deep pentobarbital sodium anesthesia. Frozen brains were sectioned and processed using tetramethylbenzidine. Sensory projections from the nose include all three subnuclei of the spinal trigeminal nucleus, paratrigeminal nucleus, and principal trigeminal nucleus.

Supported by AINA, AWIS, Sigma Xi.

# The Effect of Thaw-Lake Development on the Deposition of Plant Macrofossils

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Thaw lakes form as a result of the thawing and subsidence of ice-rich sediment. They are conspicuous features on the landscape in the arctic and subarctic regions of Alaska and western Canada. Home for many migratory waterfowl species and a diversity of invertebrate faunas, they are also a repository for terrestrial plant remains. Thaw lakes have been forming on the Seward Peninsula in Alaska for the last 100,000 years, thus spanning a time period of complex climatic and environmental change. They have the potential to provide detailed information about how vegetation responded to these changes. However, it is important to study the process by which plant material becomes incorporated into thaw-lake sediments and the extent to which the plant macrofossils represent the terrestrial vegetation surrounding the lake. A recent study of two active thaw lakes on the northern Seward Peninsula sheds light on the processes by which plant material enters a thaw-lake basin and is buried in the sediment.

I collected a series of macrofossil cores along the shores of Egg and Berry Lake and another series of cores ranging from 2-10 m offshore. The stratigraphy of the offshore cores differed markedly between the two lakes. Cores of Egg Lake contained lenses of terrestrial plant remains very close to the surface, whereas the cores from Berry Lake contained a zone of compacted terrestrial plant remains at the base. The differences between the two lakes reflects differences in their topographic setting and distribution of ground ice in the host sediments. Egg Lake formed in a plateau which contains syngenetic ice wedges that upon thawing produced a deep, steep-sided basin. In response to exposure and wave erosion the bluff sediment slumps, slides, and flows into the lake, carrying large chunks of turf into the lake. The lenses of matted organics found in the offshore cores of Egg Lake represent repeated episodes of turf that slid into the lake. When the turf enters the lake it may be buried as a single coherent mass by saturated silt and sand from the bluff, or it may fragment into smaller pieces and dissipate into a thin, continuous layer of organic-rich silt.

Berry Lake formed at the periphery of an older thaw-lake basin that drained about 1,500 years ago, and is the result of the thawing of a smaller amount of ground ice. The banks of Berry Lake are in general, less than 1.5 m high and vegetation is undercut and calves off the top of the bank more or less continuously. Wave action from strong winds churns up the lake sediment which then quickly buries vegetation that has subsided into the lake. Some of the collapsed chunks ot turf migrate along the margin of the lake basin before they are buried in the lake sediment.

This study suggests that the both the origin and ontogeny of a thaw lake profoundly influence the deposition of plant macrofossils in the lake sediment. Ultimately, they may influence the degree to which the plant remains preserved in the sediment reflect their source vegetation.



207

# THE RURAL ALASKA HONORS INSTITUTE: GATEWAY TO ACADEMIC SUCCESS?

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Following its sixth year of annual, intensive 6-week academic summer residencies for college-bound rural students, the Rural Alaska Honors Institute is engaged in a review of its structure and performance. This review period is an opportunity for RAHI to gain exposure and develop further dialogue with the scientific community and educators.

Competition for admission to RAHI has become stronger. Student performance on standardized academic testing has increased steadily since 1984, and pre- and post-test results indicate that students show significant improvement in math and verbal skills as a result of RAHI. Approximately 40 percent of RAHI students choose to specialize in science or engineering courses while at RAHI. Evaluative results leave no doubt that faculty, students, and staff rate their experiences with RAHI as academically valuable, and generally enjoyable. Communications from rural school districts indicate that students returning from RAHI for their Senior year in high school have a positive effect on their peers, and their own academic expectations are higher.

Results from RAHI alumni who subsequently enrolled in baccalaureate programs are incomplete, difficult to obtain, and their interpretation is challenging. Admissions, grade point averages, retention rates, distribution of declared majors, are all positive indicators that RAHI helps students, but perhaps not as much or as immediately as its founders and supporters originally projected. Case studies suggest that RAHI is most successful in situations where it is effectively linked with other student support systems along the way, such as the home, the school district, and campus support systems, such as Rural Student Services, Cross Cultural Communications, and NANA House.

# 2-[$^{125}$I] - IODOMELATONIN LABELS ARCTIC RODENT CENTRAL NERVOUS SYSTEM MELATONIN RECEPTORS

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In this study, the binding characteristics of 2-[$^{125}$I] - iodomelatonin is studied in synaptosomal preparations and partially purified fractions of arctic ground squirrel brain. Binding of 2-[$^{125}$I] - iodomelatonin was determined in 109,000 g synaptosomal preparations at 37°C and 0°C. Specific binding defined with 50 mm melatonin was ~ 30% to 50% of total binding and reached a plateau within 30 and was stable for 60 min. Binding activity was maintained after treatment with .3% Brig 35, a detergent. The soluble fractures where characterized by SDS-gel electrophoresis and size exclusion chromatography.

# NUTRITIONAL ALTERATION: LESS THAN BODY REQUIREMENTS

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A 56-year-old Alaskan Native female was admitted with a medical diagnosis of ruptured diverticulum, and was taken to surgery to effect a repair. Post-operation medical complications (small bowel fistulae, marginal renal function, septicemia, compromised hepatic function, encephalopathy) and nursing care complications (sleep deprivation, open draining abdominal wounds, language barrier, isolation from family support) contributed to her death 341 days after admission, after undergoing 18 surgical procedures and receiving 153 units of blood products. Her nutritional intake was totally parenteral since she was essentially NPO during her course.

An ex post facto post-mortem analysis of the patient record was used to collect and sort data into the broad categories of 1) caloric needs and 2) available nutrition. Data were analyzed for determination of the adequacy of nutritional intake.

Caloric needs averaged 2058 kcals/24 hours, with infection accounting for 18%. Total calories available averaged 969 kcals/24 hours with glucose contributing 55.7%. An average daily deficit of 1090 kcals/24 hours resulted, and the nursing diagnosis was validated: there was nutritional alteration to less than body requirements, related to hypermetabolic state.

This study identifies the need for early, aggressive preventive nursing interventions in patients at risk for post-operative complications from enteral surgical procedures. Infection control measures and stress-reduction techniques are high-priority nursing concerns in these patients.

# EFFECTS OF SHORT DAY AND COLD ON THERMOGENESIS, MOLE AND BODY WEIGHT IN ALASKAN COLLARED LEMMINGS

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To assess factors which control seasonal changes in thermoregulation, four groups of lemmings (Dicrostonyx groenlandicus) were exposed to one of the following photoperiods and temperatures: 1) long day (22h light: 2h dark) and warm (17°C) (=LW); 2) long day and cold (1°C) (=LC); 3) short day (4h light: 20h dark) and warm (SW); and 4) short day and cold (=SC). Pelage, body weight and food intake were monitored weekly. Resting metabolic rate at 22°C (RMR22) and at 7.5°C (RMR7.5) and nonshivering thermogenesis (NST = total metabolic rate after injection of norepinephrine minus RMR22) were estimated from oxygen consumption after 4, 8 and 16 wk exposure. After 8 wk, short day groups had a 15% lower RMR22 (2.40 $ml O_2/g.h$ vs 2.05) and a 21% lower RMR7.5 (4.26 vs 3.35). The lower thermal conductance in short day animals appears largely due to molt to more insulative white winter pelage which occurred in short day by 4 wk but not in long day. Neither short day nor cold of 1°C altered NST suggesting that brown fat may not change seasonally or that much lower temperatures may be required to enhance NST. Short day stimulated a greater growth than long day. After 6 wk, short day animals increased body weight 48% to 56.0g while long day animals increased only 27% to 46.6g. Cold increased food intake in both LD and SC. In spite of the greater increase in body weight in SW these animals did not increase food intake. This suggests that increased growth in short day was not directly related to food intake but may be related to decreased metabolism or increased efficiency of food utilization. Thus the pineal gland may mediate short day effects on body weight but may not be associated with food intake. (Supported in part by Amer. Mus. Nat. Hist., T. Roosevelt Mem. & L. Ellsworth Funds.)

# SYNOPTIC CLIMATOLOGY OF THE ALASKA REGION

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A statistical "synoptic climatology" technique is applied to a study of the Alaska region's ($45°N$ to $90°N$, $150°E$ to $240°E$) winter climate in order to gain insight into the prediction of the region's short-term climate fluctuations and to build a framework for future climate research. $700mb$ winter anomaly patterns have been objectively classified for a 32-year record period. 5-day mean fields have been constructed from twice daily ($00z$ and $12z$) NCAR (NMC) $700mb$ grid-point height fields in order to maintain an initial temporal scale similar to that of the medium frequency synoptic-scale feature (Blackmon, 1976). Classification results show $2$-$D$ spatial patterns resembling both the $500mb$-based winter patterns (Pacific region) described by Barnston and Livezey (1987) and the winter circulation patterns (sea level pressure) for the Beaufort Sea Coast by Moritz (1979). A statistical examination of regional surface climate, specifically, temperature and precipitation fluctuations, is in progress. Preliminary results indicate the presence of a temperature oscillation with a period of approximately ten years. Future work will include the investigation of possible associations between surface climate fluctuations and concurrent $700mb$ anomaly patterns by means of discriminant analyses.

# THE NATIONAL ARCHEOLOGICAL DATABASE IN ALASKA: A RESEARCH TOOL

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In 1984, Congress provided funds to the National Park Service (NPS) to establish a computerized bibliographic database of reports from Federal archeological projects and other work done on Federal lands. This system is known as the National Archeological Database (NADB).

The NPS in Alaska in conjunction with the State of Alaska Office of History and Archaeology has collected 3500 bibliographic records in FY88, the first year of the project in Alaska. Since, the bulk of the land in Alaska is Federal the database will eventually include bibliographic references for most of the archeological work that has been done in the state. Thus, in addition to management benefits NADB will provide a powerful research tool available to the archeological community in Alaska.

# ALASKA SEA/RIVER WEEK EXHIBIT

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The Alaska Sea/River Week program is a comprehensive, hands-on, multidisciplinary approach to aquatic education in Alaska. It focuses upon local marine, wetland, and river environments as the keys to relevant environmental education in the North. Science, mathematics, language, history, social studies, art and music are translated into the tangible, everyday experiences of children and their communities.

This display will feature the curriculum books, organized thematically by grade level and a special Monday presentation by North Pole Middle School students on the use of marine invertebrates in the classroom.

# SCIENCE FELLOWS PROGRAM DESCRIPTION

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With the support of a generous grant from the Alaska Department of Education, the University of Alaska's College of Rural Alaska is coordinating the Science Fellows Project, designed to bring science teachers (grades 7-12) together in a working relationship with science researchers from around the state. Participating teachers will be invited to attend three update workshop sessions during the school year. At these sessions scientists will share their most recent research methods and agendas with the participants, conduct hands-on lab/field sessions, and provide time for teachers to translate this information into activities for their schools. In the summer of 1989 the participants will pair with the research institutions for a minimum of one month of employment. A Title II grant will cover the costs of transportation, room and board for the update workshops. It will also pay a portion of the salary for the summer employment component. We will announce the criteria for recruitment, discuss possibilities of topics to be addressed, and answer questions from interested teachers at this meeting.

# GLACIAL DAMMING OF RUSSELL FJORD

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The Hubbard Glacier, a tidewater glacier entering the head of Yakutat Bay, advanced in early 1986 damming the entrance to Russell Fjord. The closure was reported in late May 1986. Studies during a near-closure in 1973 estimated that the fjord level could rise 30 meters per year. The water level would rise until either the glacial dam was broached or overflow occurred at the terminal moraine (elevation of 39 meters) 60 km to the south.

The glacial dam created a unique natural laboratory and permitted us to address two questions. This region of the Alaska coast is ungauged, so the closure presented an opportunity to measure runoff by recording the water level rise. The glacial dam and the accumulating surface freshwater layer isolated the deep fjord waters, preventing deep water renewal by tides and exchange at the surface. Anoxia was expected to occur within about two years, so the event presented an opportunity to observe the onset of anoxia.

We deployed two Aanderaa current meters about one week after closure. They were anchored to the bottom (placed originally at 7 meters) and were equipped with pressure and temperature transducers. Data was recorded at 30-minute intervals. We also conducted a hydrographic survey from an inflatable boat in mid-September 1986. The fjord water level rose 24 meters before the dam eventually failed on 7 October 1986. Some 5.3 cubic kilometers of water were discharged into Yakutat Bay following the outbreak; tides were evident in 26.5 hours.

This study was supported by the Institute of Marine Science and by the NSF Division of Polar Programs through grant number DPP 86-17750. The U.S. Forest Service provided valuable assistance with logistics and lodging.

# PRELIMINARY ISOELECTRIC FOCUSING, AMINO ACID ANALYSIS AND PRIMARY STRUCTURE OF SOCKEYE SALMON HEMOGLOBINS

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The life cycle of the Sockeye salmon (Oncorhynchus nerka) includes both fresh water early development and oceanic adult periods. These salmon have multiple hemoglobins whose functional evolutionary significance is still unresolved. The presence of these various hemoglobins may be advantageous to assuring adequate oxygen transport and unloading over a wide range of environmental conditions. In order to test this hypotheses, a more detailed molecular characterization of the various hemoglobin components must be performed. In this study we have used isoelectric focusing to establish pH titiation curves for the components. This data can be related to thermal stability and solubility of these hemoglobins.

We also isolated the individual polypeptide chains and compared their amino acid compositions to other fish hemoglobins. A preliminary amino acid sequence of component 1 will also be presented.

# THE ALASKA BRIDGE PROGRAM – AN AVENUE FOR HEALTH CAREER ENHANCEMENT FOR ALASKAN NATIVES

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To address the scarcity of rural Alaskan Native health care providers, the locally trained village Community Health Aide was chosen as the ideal candidate for a developmental program to facilitate rural student success in university Physician Assistant Programs.

Obstacles to University success included, inadequate academic preparation, geographic isolation, culturally determined communication differences and few role models.

The goal of the Bridge program was to provide a supportive, culturally sensitive transitional environment in which rural students could assess their own readiness for university studies. An integrated curriculum design emphasized supportive group participation and interactive learning. Students developed study skills and academic competency in mathematics, science, communication skills, along with the urban adaptation skills needed for success in a demanding University program. Clinical experiences offered stimulating learning opportunities which reinforced the relevance of basic science to medicine.

Students acquired a 90% knowledge increase in some academic areas. More importantly, students developed a positive image of themselves as learners and a repertoire of skills necessary to attain their maximum potential in Western schooling.

Whether students choose to continue their education or not, the enhanced self image as successful learners acquired through involvement in the Bridge program will be projected to the community and to their children.

# PALEOECOLOGY OF A LATE-QUATERNARY CAVE DEPOSIT ON THE PORCUPINE RIVER ALASKA

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Lower Rampart Cave-1 is a small cave in a limestone/dolomite belt along the Porcupine River, northeast Alaska. The cave may have obtained its configuration by fluvial processes when the Porcupine River was approximately 30 meters above its present base-level, perhaps during a catastrophic flood at the end of the last glacial interval. The cave began to fill with unconsolidated sediment around the end of the last glacial stage and has continued to fill through the Holocene. In the late Wisconsin one of more glacial lakes in northern Yukon Territory breached the upper Ramparts of the Porcupine River and drained, leaving a scabland in the lower Ramparts.

LRC-1 contains a heterogeneous deposit consisting of inorganic sediment and fossil bone. The late-Quaternary large mammal fauna consists of *Mammuthus, Equus, Bison, Ovis, Rangifer,* and possibly *Ursus*; the Holocene fauna consists of *Rangifer* and *Ursus*. The fossil large mammal bones were brought to the cave by carnivores: probably by *Vulpes* and *Canis* during the Pleistocene. Extensive carnivore gnawing on the bones suggests that the cave may have been utilized as a rendezvous site during the spring and early summer seasons. Deciduous bear canines indicate that the cave was a bear den throughout the Holocene and perhaps in the late Pleistocene. A pedogenic calcite in the lower part of the section, and below the drip-line, may represent a stratigraphic marker of the early-Holocene thermal maximum, approximately 9-11,000 years ago. The first dated archaeological material appears about 3,500 years ago and consists of a hearth and several lithic flakes. Lower Rampart Cave-1 contains a stratigraphic record spanning the last 25,000 years and offers an unique opportunity to better understand the environment of the late Wisconsin glacial/interglacial transition.

# ARCHEOLOGICAL SURVEY AND INTERDISCIPLINARY RESEARCH IN THE BERING LAND BRIDGE NATIONAL PRESERVE, SEWARD PENINSULA

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An archeological survey conducted in the Bering Land Bridge National Preserve during 1985 and 1986 has disclosed an interesting array of archeological sites. These sites represent most of the known regional cultural expressions from 4,500 years BP to historic Inupiat times. Special studies carried out in conjunction with the survey include the following topics: volcanic history of the Espenberg maars, thaw lake deposits as repositories of paleoenvironmental information, faunal identifications from Trail Creek Caves, coastal erosion rates and characteristics and sand ridge geomorphology. Research results and implications are highlighted.

# THE UTILITY OF ANALYSIS OF MITOCHONDRIAL DNA IN THE STUDY OF ALASKAN POPULATIONS

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Because of its simplicity, rapid rate of change and maternal mode of transmission mitochondrial DNA (mt DNA) has become a popular molecule for study among those interested in questions concerning the evolutionary history and structure of populations. The major theme of our research is to use mt DNA as a molecular marker in order to learn more about relationships and distributions of individuals within and among populations in Alaska.

We have used restriction fragment analysis as well as direct sequencing of cell free amplifications of (mt) DNA to 1.) identify individuals of unknown phylogenetic affinity, 2.) estimate extents of gene flow between contiguous populations and 3.) date periods of phylogenetic separation and adaptive radiations.

Our observations on phylogenies, molecular relationships and population structuring have been particularly useful to wildlife managers as well as students of historical population biology. Significant observations on the molecular population genetics of waterfowl, polar bears and native Alaskans will be discussed.

# IDENTIFYING ALASKAN FRESHWATER LARVAL FISH

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Identification of larval fish is important for assessing fish populations and human impact on fish ecosystems, but is difficult because physical characteristics of many larval fish are similar. Proper identification requires a key; presently there is no key to freshwater Alaskan fish larvae. This study looked at the feasibility of producing a key for the larval stages of several Alaskan freshwater fish. Precise illustrations of several stages of larval development were done for six species. These species were: sheefish, Stenodus leucichthys; Arctic grayling, Thymallus arcticus; Arctic char, Salvelinus alpinus; Dolly Varden, S. malma; longnose sucker, Catostomus catostomus; and slimy sculpin, Cottus cognatus. They were laboratory-reared or collected near Fairbanks. Photographic, microscopic, and camera lucida techniques were used to make technical illustrations and morphometric measurements for each stage of the six species. The study indicated that sufficient literature to complete the key exists for all species except several whitefishes, for which there is little or no information.

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# RECENT OBSERVATIONS ON HUBBARD GLACIER, ALASKA

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The 1986 closure of Russell Fiord by Hubbard Glacier focused attention on the century-long advance of the Hubbard Glacier. The calving terminus of Hubbard Glacier is about 6.5 kilometers wide in Disenchantment Bay and about 3.5 kilometers wide in Russell Fiord. The 1986 ice dam was formed by an unusually rapid advance along a 500 meter section of the terminus opposite Gilbert Point, a land peninsula that separates the bay and fiord.

Vertical photography in August 1977, August 1987, January 1988, May 1988, and August 1988 has been used to map the position of the calving ice face. The width-averaged position changes (positive values indicate advance) for the Disenchantment terminus for each respective time interval, in meters per year, are 44, 94, 125, and 159. For the Russell terminus, the width-averaged position changes are 85, -190, 94, and 119 meters per year, respectively.

In the 1986 ice dam area, the channel between the glacier's terminus and the shoreline at Gilbert Point was 1170 meters wide in 1977, was closed completely between May and October 1986, was 500 meters wide in August 1987 and January 1988, 400 meters wide in May 1988, and 420 meters wide in August 1988.

July 1988 bathymetry in the 1986 ice dam area found that the narrowest part of the channel was 30 to 35 meters deep with a 15-meter-deep lip about 600 meters toward the outlet, in Disenchantment Bay.

Ice speed has been measured on the Valerie Glacier, a major tributary to the lower Hubbard, using a satellite-linked telemetry system. These data indi- cate that the Valerie's speed has a seasonal range of 400 to 2000 meters per year. Valerie Glacier ice speed exceeded 10,000 meters per year for a few days in June 1986. There has not been a repetition of such an event. Speed of the lower Hubbard has been measured by comparing the locations of surface features on the time successive vertical photography. Speeds of up to 4500 meters per year has been measured.

# CONSERVATION EDUCATION IN THE NORTHWEST TERRITORIES

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The position of Conservation Education Officer, in conjunction with headquarters in Yellowknife, is responsible for the development and delivery of educational programs dealing with departmental concerns such as the environment, wildlife, and their management. The major goal is to target school children and work within the curriculum, with teachers, to build a respect for the environment, wildlife, and to explain the many acts, ordinances and regulations governing them today. Also high in priority are the resource users, followed by the general public and the southern and foreign publics.

Delivery of programs is coordinated by the Conservation Education Officer through the Renewable Resource Officers in each community. Content is a combination of scientific and traditional knowledge. The majority of presentations are conducted in public schools, although many informal discussions arise with tourists, at Hunters and Trappers meetings, or when officers meet hunters and campers out on the land. Many resource materials have been developed to facilitate presentations, such as videos, films, TV spots, booklets, pamphlets, slide and resource libraries, kits and games. Emphasis is placed on obtaining or creating material that is unique to the north.

The future direction of Conservation Education will focus on expanding our programs, resources, and the range of our audience. Clubs and various interest groups are being encouraged to make use of our programs, and a close working relationship with schools and resource harvesters will continue to be fostered.

The native culture is based on the utilization of wildlife. As such, the understanding and support of departmental programs is crucial to the future harmony between northerners and their resources. The Conservation Education division of the Department of Renewable Resources continues to face this challenge in an effort to serve the residents of the Northwest Territories.

## INDEX OF AUTHORS


A

Ady, Janet Carrier ..... 33
Aigner, Jean ..... 143
Akasofu, Syun-Ichi ..... 25
Allaback, Paul ..... 221, 225
Allaye-Chan, A. C. ..... 55, 57
Anderson, J. H. ..... 181
Andrews, Martha ..... 34
Appelbaum, Richard ..... 86
Armbruster, W. S. ..... 205, 210, 212
Arps, Peggy ..... 13
Ashmun, Louise ..... 92
Aspnes, John D. ..... 159, 164, 166

B

Barnes, Peter W. ..... 113
Barnhardt, Carol ..... 73
Barnhardt, Ray ..... 74
Barrett, Helen ..... 83
Batten, Alan ..... 226
Begét, Jim ..... 26
Behlke, Jane ..... 98
Benedict, R. ..... 114
Benson, Carl ..... 115, 131
Booker, John ..... 186, 235
Borchert, Mary Ann ..... 233
Bowen, Paul ..... 35
Bowyer, R. Terry ..... 218
Boyce, Conrad ..... 117
Braddock, Joan Forshaug ..... 195
Bramble, William J. ..... 65
Breitenberger, Eric ..... 116
Brice, Glyn ..... 85
Brockett, Bruce E. ..... 122
Brown, Edward J. ..... 195
Brown, Neal ..... 117
Bryant, John ..... 193
Bulkow, Lisa ..... 182
Burnham, David ..... 139
Burnham, Kim ..... 21
Bush, Anita ..... 246
Bushnell, Don D. ..... 86
Button, D. K. ..... 17

C

Cameron, Raymond D. ..... 57
Candler, Rudy ..... 36
Chacho Jr., Edward F. ..... 114, 122
Chapin III, F. Stuart ..... 196
Cheek, L. M. ..... 183
Christensen, R. ..... 191
Clark, M. D. ..... 47
Cole, Henry ..... 227
Colinaux, Paul A. ..... 238
Cowan, Peggy ..... 66

D

Daniello, Denise L. ..... 235
Davidson, M. ..... 189
Davis, Stanley D. ..... 48
Daynes, Raymond A. ..... 21
Dean, Glen ..... 236
Dean, Natalie ..... 236
Deviche, Pierre ..... 14
DeVoe, Donna L. ..... 212
Dixon, Jerry S. ..... 215, 237
Dixon, Mim ..... 231
Douthat, D. ..... 169
Duffy, Lawrence ..... 11, 15, 245, 253

E

Easton, N. Alexander ..... 87
Ebbesson, Lars O. ..... 18
Ebbesson, S.O.E. ..... 179, 183
Echelmeyer, K. ..... 114
Edwards, Mary E. ..... 207
Eilers, Joseph ..... 223
Eisner, Wendy R. ..... 238
Esch, David C. ..... 37
Escher, George A. ..... 88, 89

F

Falk, Marvin W. ..... 27
Feil, P. ..... 184, 240
Feist, Dale D. ..... 245, 247
Ford, Jesse ..... 223
Foster, Martin ..... 90
French, John S. ..... 16, 28
Frentzen, Ann M. ..... 75, 244
Friedman, Irving ..... 115

G

Gallagher, Thomas J. ..... 91, 147
Gatterdam, R. W. ..... 170
Gislason, Gary ..... 167
Gladden, James N. ..... 148
Gleason, Jim ..... 115
Glenn, Richard K. ..... 239
Goldberg, S. ..... 240
Gordan, Leslie ..... 92
Gosink, J. J. ..... 17
Greenberg, Donald ..... 93
Green, Linda ..... 61
Greene, E. R. .. 184, 185, 240
Griffiths, W. B. ..... 202
Gunter, Pauline ..... 137
Guthrie, R. Dale ..... 29

H

Hackett, P. H. . 184, 185, 240
Haglund, Donn ..... 224
Haneman, Vincent ..... 59
Hare, Matthew P. ..... 216
Harrington, John ..... 253
Harrison, W. ..... 114
Hart, Leslie Starr ..... 138
Hawkins, Joe ..... 160
Haynes, Terry ..... 61, 133, 135, 145
Heifetz, Jonathan ..... 49, 52
Hellekson, Carla ..... 186
Henrichs, Susan M. ..... 199
Herring, John ..... 96
Hild, Carl M. ..... 94
Holleman, D. F. ..... 55
Holmes, Tim P. ..... 139
Honrath, Richard E. ..... 118, 119
Hopkins, David M. ..... 207, 208
Huang, Scott L. ..... 161, 162, 165
Huang, Sen-Wei ..... 171
Hulsey, Leroy ..... 153

I

Inouye, Ron ..... 63, 104
Irons, John G., III ..... 241

J

Jacobson, Elaine M. ..... 95
Jaffe, Daniel A. ..... 96, 118, 119, 131
Jarrell, Susan DeLisa ..... 242
Jeffries, Martin O. ..... 120
Jenkerson, Sue Anne ..... 182
Johnson, Scott W. ..... 49
Juday, Glenn Patrick ..... 225, 226

K

Kawagley, Oscar ..... 74
Keller, C. ..... 191
Keller, John W. ..... 18
Kidd, Janet G. ..... 208, 209, 243
Kielland, Knut ..... 198
Kinney, K. ..... 169
Kline, Jr., Thomas C. ..... 197
Klunder, Ken ..... 38
Koski, K. V. ..... 49, 52
Kowalsky, James E. ..... 76, 244
Kramer, Donald E. ..... 39
Krimmel, R. M. ..... 259

L

Lambert, Pat ..... 172
Lanctot, Frederick ..... 174
Landers, Dixon ..... 223
Lanier, Anne P. ..... 187
Lawhead, B. E. ..... 56
Lawson, Daniel E. ..... 121, 122
Lennox, Chuck ..... 40
Luick, Jack R. ..... 220
Luick, T. J. ..... 245
Lyons, Teresa ..... 246

M

Maier, Hilmar A. ..... 247
March, R. S. ..... 123
Maxwell, Howard E. ..... 77
Mayo, L. .... 31, 45, 50, 109, 111, 123
McDaniel, Terry ..... 199
McGuire, A. David ..... 210
McKendrick, Jay ..... 200
McMahon, Brian J. ..... 182, 187
Merrill, Yvonne ..... 97
Merrit, R. P. ..... 155, 159, 164, 166
Middaugh, John ..... 182
Milkovich, Mary F. ..... 248
Miller, L. Keith ..... 241
Mischler, Janet K. ..... 188
Moore, Greg ..... 67
Moore, Gregory D. ..... 78
Morack, John ..... 83, 98
Morehouse, Thomas A. ..... 229
Morton, Susan D. ..... 140, 249
Mosely, Kathy ..... 99
Murphy, M. L. ..... 49
Murphy, Nancy ..... 250, 251
Murphy, S. M. ..... 56

N

Nebert, D. L. ..... 252
Nelson, Partricia ..... 68
Norton, David W. ..... 71, 79, 244

O

Oechel, Walter C. ..... 124
O'Leary, Marion H. ..... 19
Olmsted, Coert ..... 173
O'Malley, Mary ..... 15, 18
Osterkamp, T. E. ..... 125
Oswood, Mark W. ..... 241
Owens, Gregory J. ..... 80

P

Parker, Walter B. ..... 69
Parkinson, A. J. ..... 189, 190
Paul, Les ..... 51
Paustian, S. J. ..... 47
Pedersen, Sverre ..... 141, 217
Perkins, Maynard ..... 100
Peterson, K. M. ..... 201
Ping, San ..... 15
Plumley, Gerald F. ..... 20
Porchet, A. ..... 245
Prechtel, Anton S. ..... 126
Preston, Jim ..... 101

Q

Quang, Pham Xuan ..... 174

R

Rabiego, M. ..... 189
Rachlow, Janet L. ..... 218
Ray, Scott R. ..... 241
Raymond, C. ..... 114
Reeburgh, W. S. ..... 252
Reimnitz, Erk ..... 113
Reynolds, Rebecca ..... 15, 253
Rice, Bud ..... 41
Roach, R. C. ..... 184, 185, 240
Roth, M. G. ..... 175
Royer, Thomas ..... 111
Roussain, Cheryl ..... 254
Rudolph-Pfau, K. M. ..... 190
Russell, D. E. ..... 55
Rutt, G. Clifford ..... 18

S

Salmon, David K. ..... 127
Sattler, Robert A. ..... 211, 255
Sauer, Jody ..... 253
Saupe, Susan M. ..... 202
Savage, Candace ..... 102
Schaaf, Jeanne ..... 256
Schell, D. M. ..... 202
Schmidt, Gregory W. ..... 20
Schmitt, Mary K. ..... 21
Seater, Ronald ..... 93
Seifert, Richard D. ..... 103
Selland, M. ..... 184, 240
Senkpeil, Aron ..... 87
Shaver, Gaius R. ..... 196
Shields, Gerald F. ..... 22, 257
Slaughter, Charles W. ..... 42
Smith, Steve ..... 63, 68, 104
Speck, R. C. ..... 81, 162, 165
Spell, B. D. ... 157, 159, 163, 164, 166
Sonafrank, Nacey B. ..... 18
Stephens, Sidney ..... 251
Stickney, Alice ..... 219
Stricks, James ..... 98
Sturm, Elizabeth A. ..... 258

T

Tallas, Peter G. ..... 220
Thedinga, John F. ..... 52
Thomas, Monica E. ..... 105
Trabant, D. C. ..... 123, 259
Turner, A. A. ..... 191, 236

U

Utley, Philip L. ..... 131

V

Viavant, Tim ..... 203
Visse, Ellen Vande ..... 106

W

Wainwright, Robert B. ..... 182, 187
Waters, Donna ..... 260
Weller, Gunter ..... 23, 128
Wells, T. ..... 191
Wendler, Gerd ..... 129
Wesser, Sara D. ..... 212
White, R. G. ..... 53, 55, 57, 213, 220
Williams, Jr., Richard S. ..... 130
Willis, Barry ..... 70
Wilson, M. ..... 164
Wilson, N. ..... 184, 240
Wolfe, Robert J. ..... 149
Wood, William D. ..... 42

X, Y

Yamasaki, K. ..... 165
Yerian, Sue ..... 107
Young, Gerry ..... 43, 108
Young, Oran ..... 231

Z

Zarling, John ..... 151
Zhao, Y. Q. ..... 166
Zukowski, Matthew D. ..... 131

223